CULTIVATION TRENDS IN THE BUFFER ZONES OF EAST AFRICAN RANGELAND PROTECTED AREAS

The Case of Ngorongoro and Loliondo in Tanzania

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ABSTRACT

This study examined socio-economic factors that drive the conversion of the rangelands into cultivation in a context of rangelands managed under conservation and development land use policies. Specifically, it compared the extent and factors of rangeland conversion to cultivation between and within land-use zones managed under conservation-biased policies and those managed under development-biased policies. The study was conducted in Ngorongoro Conservation Area (NCA) and Loliondo Game Controlled Area (LGCA) buffer zones of the Serengeti National Park (SNP), chosen on the basis of generally comparable ecological, socio-economic and cultural backgrounds, but different land-use policies. NCA pursue conservation compatible policies whereas LGCA pursue land-use policies that allow for almost all sorts of land-uses.

The results show interesting variations in the level of households' involvement in cultivation and the magnitude of rangeland conversion that reflect the varied influence of conservation and development policies. NCA had more households that were cultivating (96%) compared to LGCA (87%). However, there was more land converted to farmlands in the LGCA (4.02 acres per household), as opposed to the NCA (2.36 acres per household).

Conservation policies, particularly the controls over cultivation, in-migration, and management of the range resources in the NCA account for the low levels of rangeland conversion in the NCA. All the NCA sample households (100%) wanted to cultivate, and majority would increase the size of their farms if not for the controls on tools to be used. In the contrary, development-biased policies which do not regulate in-migration and land-use were encouraging rather than limiting conversion of the rangelands. In the LGCA, the only limitation was ecological conditions in some of the sites. In-migrant cultivators and the use of tractors and ploughs were allowed, and extension services for the development of cultivated crop were available.

Households of different socio-economic and occupational backgrounds – pastoralists and non-pastoralists, residents and in-migrants, the poor and the rich - were all cultivating, but with a generally low acreage compared to cultivator communities outside the buffer zones. Wealthier pastoralists and the few settled pensioners however, owned and cultivated larger farms in both zones. In all these sub-groups, cultivation was contributing significantly to subsistence needs and herd-building.

Despite the increasing cultivation, land cover change associated with human activities between 1975 and 2000 was very small compared to other buffer areas in the east African rangelands protected areas. This suggests that the current levels of cultivation in the study area can be maintained without much threat to the purposes for which the buffer zones are created. It was therefore concluded that the buffer zones ought to be managed under policies that regulate in-migration and land-use, foster growth in the livestock economy, and, allow small-scale cultivation among pastoralists.

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ABBREVIATIONS USED IN THIS STUDY

CBC	Community Based Conservation
DRSRS	Department of Rangeland Surveys and Remote Sensing
GR	Group Ranch
HI	Land-cover change (decline) associated with human impacts
INC	Land-cover change associated with natural succession. Increase in vegetation cover
LCC	Land Cover Change
LGCA	Loliondo Game Controlled Area
MGR	Maswa Game Reserve
MMNR	Masai-Mara National Reserve
MTNRE	Ministry of Tourism, Natural Resources and Environment
NCA	Ngorongoro Conservation Area
PAs	Protected Areas
RG	Decline in land-cover change associated with wildlife and livestock

SEU	Serengeti Ecological Unit
SNP	Serengeti National Park
TWMC	Tanzania Wildlife Monitoring Centre
TANAPA	Tanzania National Parks Authority

A GLOSSARY OF MAASAI AND OTHER NON-ENGLISH TERMS USED

Murran	A Maasai warrior, after initiation
Enkang or Boma	The Maasai homestead, usually with more than one family, more than one elder
Enkaji (pl. enkajijik)	Houses of individual wives married to the head of the household of a single family. In this study, enkaji is referred to as 'sub-household'
Engutoto	A settled locality, usually with all the basic resources (water, pasture for calves and sick livestock, and sometimes land for small-scale cultivation etc.)
Olokeri	Area of pasture specified for calves and sick livestock, located within a locality/close to homesteads
Olmarei (pl. ilmarata)	A Maasai household, and also the head of a household.
Bustani (pl. mabustani)	Small cultivation plots in Maasai homesteads commonly less than one-fifth of an acre, usually located at the back of individual sub-households.

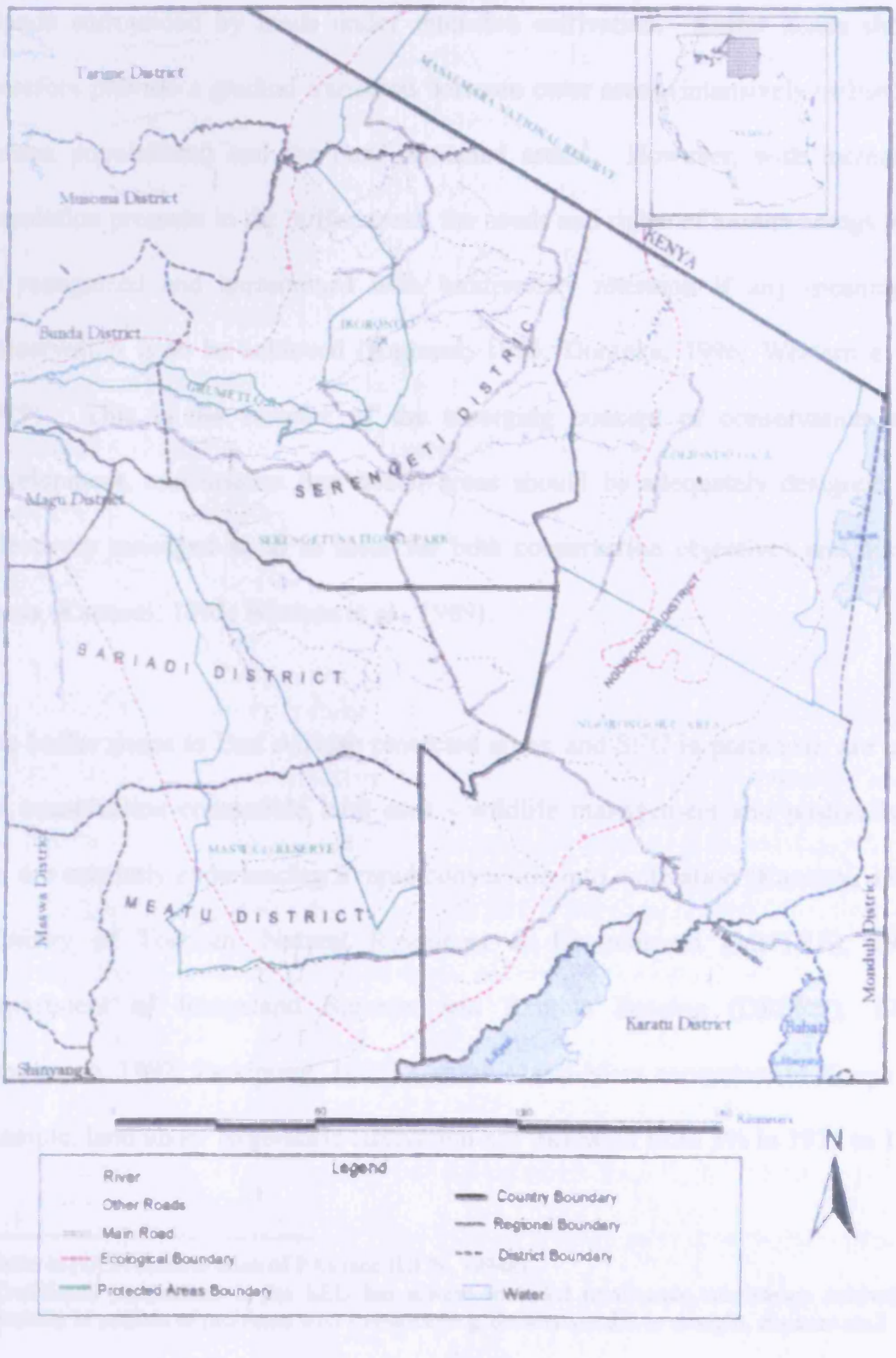
CHAPTER 1

INTRODUCTION

1.1 Introduction

This study is part of a larger project titled "Policy, Cultivation and Conservation in East African Rangeland Buffer Zones", which investigates the factors driving the spread of cultivation in key East African savanna protected areas (PAs). The purpose of this sub-study is to examine socio-economic factors driving the increase of cultivation in the buffer zones of the East African rangeland protected areas, with a specific focus on the Serengeti Ecological Unit (SEU) in Tanzania. The SEU includes Serengeti National Park (SNP), Maswa, Ikorongo and Grumeti Game Reserves (GR's), Ngorongoro Conservation Area (NCA) and Loliondo Game Controlled Area (LGCA) in Tanzania, and Masai-Mara National Reserve (MMNR) in Kenya. Map 1 shows the location of the SEU in East Africa. The region (SEU) is of outstanding biological, scientific, aesthetic and economic values, and is designated as a biosphere reserve and a world heritage site (Ministry of Natural Resources & Tourism, 1985; Ad Hoc. Ministerial Committee on Ngorongoro, 1990: Kauzeni, 1995).

MAP 1: SERENGETI ECOLOGICAL UNIT (SEU) GEOGRAPHICAL LOCATION



1.2 Background to the problem

In conservation policies, the importance of buffer zones emerges from the fact that the values for which PAs are created are affected by surrounding land uses (Hales, 1989: Dasman, 1983; McNaughton, 1989). As such, PAs can not survive as islands surrounded by lands under intensive cultivation. Buffer zones should therefore provide a gradual transition between outer areas (intensively utilised by human populations) and the core protected areas[1]. However, with increasing population pressure in the buffer areas, the needs and rights of human beings must be recognised and harmonised with biodiversity retention if any meaningful conservation is to be achieved (Kauzeni, 1995; Dompka, 1996; Western et al., 1989). This is the essence of the emerging concept of conservation with development, and implies that buffer areas should be adequately designed and effectively managed so as to cater for both conservation objectives and human needs (Kauzeni, 1995; Western et al., 1989).

The buffer zones to East African protected areas, and SEU in particular, are used for conservation-compatible land uses - wildlife management and pastoralism[2], but are currently experiencing a rapid conversion into cultivation (Kauzeni, 1995; Ministry of Tourism, Natural Resources & Environment (MNTRE), 1996; Department of Rangeland Surveys and Remote Sensing (DRSRS), 1994; Amuyunzu, 1997; Parkipuny, 1997). In the Masai-Mara ecosystem in Kenya for example, land under large-scale cultivation has increased from 3% in 1975 to 12%

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[1] Refer to IUCN classification of PAs (see IUCN, 1994a).

[2] Traditional pastoralism in the SEU has always included small-scale subsistence cultivation, especially in periods of problems with livestock (e.g. decimation due to drought, diseases etc.)

in the 1990's (Amuyunzu, 1997). In Tanzania, rangeland conversion is also picking up. The Conservation Services International (CSI) and Frankfurt Zoological Society (FZS), (1997) reports a doubling of land under cultivation in Loliondo between 1987 and 1992. There is also an increase in human settlements of agropastoral Wasukuma in the Maswa Game Reserve (MGR) border (Makacha, Msingwa and Frame, 1982; MTNRE, 1996), which is undoubtedly associated with more land being put into cultivation. Furthermore, McCabe, Mollel and Tumaini (1997) observed a 1% p.a. increase in cultivated land in NCA only two years after the cultivation ban was lifted in 1992. The increase is non-significant, particularly when compared to other SEU buffer areas. However, it is an indicator of increasing uptake of cultivation among pastoral communities as it represents only subsistence cultivation by Maasai (normally small scale), and it does not include medium and large-scale non-Maasai cultivation which have a higher potential for rangeland conversion.

The few examples above indicate that rangeland conversion (into cultivation) in the SEU buffer zones is increasing rapidly. However, there is potential major conflict between cultivation, conservation and development in these areas, and the increasing cultivation appears to be a threat to both conservation objectives and the livelihoods of pastoral communities in and around the PAs thus:

1. Increasing cultivation in the buffer zones is linked to escalating biodiversity losses as parks become isolated from their wider ecosystems (Newmark, 1993), and to declines in wildlife populations living in the buffer areas (Norton-Griffiths, 2001; DRSRS, 1994). In Narok district

(Kenya) for example, Amuyunzu (1997), citing Grunblatt et al. (1995), reports declines of up to 37% of large wild herbivores over the last 20 years, the period when rangeland conversion increased from 3% to 12% in the Masai-Mara buffer area of the district. The effects of increasing cultivation in the rangelands (Kenya) are further supported by aerial wildlife censuses by the Kenya Rangeland Ecological Monitoring Unit (KREMU). The censuses show that buffer areas that are generally managed under pastoralism have remarkably high concentration of wildlife compared to national parks (with no human habitation) bounded by agricultural communities (Homewood & Rogers, 1991). The EU – DFID project analysis of remotely sensed data (1975 – 2000) and wildlife counts covering the entire SEU - Kenya and Tanzania estimate wildlife declines of around 50% over the last two decades in Kenya, mainly because of increasing mechanized agriculture associated with loss of habitat for wildlife (Homewood et al., 2001a)[3]. Such impact was not observed on the Tanzanian part where cultivation in the buffer zones is still low.

2. While increasing cultivation in the rangelands may be equated with 'development' on the argument of intensifying land use to feed the growing human populations, the whole process is, on the other hand, associated with diminishing dry-season grazing lands potentially leading to marginalisation and loss of pastoral livelihoods (Sinclair & Fryxell, 1985; Galaty, 1994; Scoones, 1991, 1992). Scoones (1992) summarizes case studies across sub-Saharan Africa which clearly demonstrate a situation

[3] See Ottichilo, et al (2001); serneels, Saidi and Lambin, 2001.

where access to dry season pastures is rapidly diminishing with increasing cultivation. The consequences are disrupted grazing systems, which may lead to both environmental damage (through over-grazing) and losses in livestock productivity. Parkipuny (1997), for example, associates the observed decline in per capita livestock among Maasai pastoralists in the SEU (Potkanski, 1995; CSI and FZS, 1997; McCabe et. al., 1997) with the increase in cultivation among other things. With this perspective, it seems that while cultivation may mean easier access to grain (basic supplement in pastoral diet), livestock remains at the centre of Tanzanian pastoralists livelihood strategies, particularly in meeting subsistence requirements and other socio-cultural obligations (Potkanski, 1995; Lane, 1996). Rangeland conversion into cultivation is therefore seen as a threat to the livelihoods of pastoral communities, particularly when executed from outside the pastoral community.

1.3 The Problem

Alongside the land use conflicts outlined above, human population growth continues unabated and conversion of the East African rangelands into cultivation is increasing rapidly. This presents a practical challenge on how to manage the buffer zones effectively, so as to meet both the objectives of conservation and the livelihood and developmental needs of the growing population. An understanding of the factors which drive land use conversion in these areas, and the effects (of this conversion) to peoples' livelihoods at household level will provide data useful for suggestions towards the formulation of informed and practical conservation and development policies.

Studies in the Kenyan part of the East African rangelands provide several suggestions about motives behind the increase in land use conversion which include livelihood/survival strategy for food security; entrepreneurial strategy of maximising returns to land; and, strategies of obtaining title/rights to land (Grandin, 1988; Graham, 1988; Pearce, 1996; Norton-Griffiths, 1995; Thompson & Homewood, 2001; Thompson, 2002). Grandin (1988) and Graham (1988) view the conversion process as related to the policy of privatization of pastoral lands among other factors, as land becomes a commodity to be sold out (by an individual), especially at times of difficulty. On the contrary, studies of cultivation in the buffer zones of SEU in Tanzania (Runyoro, 1993; McCabe et. al., 1997; McCabe, Mollel & Tumaini, 1997) do not, at least at present, paint a clear picture of motives other than that of food security. The studies confine themselves to only small-scale cultivation practised by Maasai inhabitants, which they ascribe to subsistence motives. Yet, evidence abounds that alongside the small-scale subsistence cultivation by the pastoral Maasai, households from a wide range of socio-economic and residential status practise cultivation of different scales in the area. These include large-scale agro-business ventures, e.g. the seed beans in Tarangire and the wheat schemes in Hanang and in Loliondo (McCabe, 1997; Parkipuny, 1997; CSI & FZS, 1997), which however are not allowed in the NCA. No systematic study exists to explain this.

The present study examines the different motives and processes through which households from different economic, cultural and ethnic backgrounds influence conversion of rangelands of the SEU buffer zones into cultivation. The role of in-migration of human populations as well as that of land tenure system (and its recent changes) in the process is also addressed.

1.4 Research Objectives

The main objective of this study was to identify and describe the socio-economic factors driving conversion of the East African rangelands into cultivation. This is important in the development of conservation and development policies, which cater for both the objectives of conservation and the needs of a growing human population.

Specifically, the study aimed to:

1 Analyse and describe the types and patterns of, and actors in, increasing cultivation in the NCA and LGCA buffer zones of the Serengeti Ecological Unit.

2 Identify and describe the factors (and related processes) which influence the increase of cultivation in the NCA and LGCA.

3 Document the implications (knock-on effects) of rangeland conversion on pastoralism. Focus is on livelihoods diversification/cultivation among

pastoralists and livestock performance in relation to access to range resources e.g. wet/dry season pastures, herd-building, etc.

4 Compare different land use policy zones to see how conservation and development outcomes result[4], and what viable policies and strategies may be formulated to minimize conflicts and achieve sustainable rangeland management.

1.5 Significance of the study

As well as its contribution to the general body of knowledge on rangelands development and management processes and factors/forces behind social change, the study is important in the following ways:

Firstly, it generates useful information and knowledge for policy-makers in the study area and other areas in Tanzania, particularly in situations of conflicting conservation and development policies. By identifying the actors and factors behind the increasing rangeland conversion, the study provides information which is useful in the formulation of informed policies that can harmonise the needs of a growing human population and biodiversity retention, thus achieving meaningful and sustainable conservation.

Secondly, the study is significant in that it contributes to the current debates among development specialists, researchers and other decision-makers dealing with conservation and development issues in East African rangelands and elsewhere in the world. It provides valuable information in assessing land-use and livelihood changes resulting from sets of conservation and development policies of PAs.

In addition, the study suggests practical means to assist pastoralists in the study area to manage and regulate the changes occurring in their habitat and avoid potential conflicts that could arise in land use practices that combine livestock and cultivation in typical buffer zones of the East African PAs.

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[4] A parallel study by Mick Thompson in Masai-Mara, Kenya provided data for national level comparisons.

CHAPTER 2

CONSERVATION AND DEVELOPMENT IN THE RANGELANDS

2.1 Introduction

Land use is normally a product of history, economics, ecology, global politics and demography, although the type of resource use reflects the potential of ecological factors. Theoretically, land potential constrains rural population densities and the ensuing forms and patterns of land use and tenure rights (Clarke, 1970; Galaty, 1994). In the broadest sense of land use, cultivation dominates the wetter areas while pastoralism and wildlife management are successfully adapted to the arid and semi-arid environment (Fratkin, Galvin & Roth, 1994). However, as population grows in numbers and density, affluence, and levels of interaction, and as macro level policies over resource use enter the fray, transformations in land use and tenure/control become inevitable (Boserup, 1965, 1981; Clarke, 1970; Harrison, 1992). When these transformations involve conversion of rangeland into cultivation, it is the wet, dry-season pasture lands which fall victim to cultivation because of their overlapping potentials (Little, 1992; Galaty, 1994). Conversely, the various strategies of resource management observed at household level in different communities, as well as in communities of essentially similar cultural backgrounds, are a reflection of adaptations to situations of inadequacy of, or competition for, resources manifest in these factors over time and space.

The commonly used approach in the analysis of changes in rural land use is Boserup's (1965) model of land use intensification in agrarian communities synergized by increasing human populations on finite land resources. For pastoral communities the transformation takes a gradual shift - from communal ownership with hunting when resources are abundant, through pastoralism when resources are plentiful, to private or collective control of commons with mixed arable-livestock production and controlled grazing (Harrison, 1992). The main assumption is a situation of increasing human populations without a corresponding growth in the pastoral production system. In the same framework, Mace (1993) provides an optimality model useful in predicting the way pastoralists may take up cultivation and vice versa, with changing levels of output in a pastoral production system (based on trends in livestock population and crop yields).

These models assume a situation of transition within (and by) a community from one mode of land use to another, resulting mainly from increasing pressure on land resources. However, a wide range of factors, including conditions of stress on household economy/means of subsistence, access to (and tenure of) resources, market forces, changing social relations, etc. have triggered diversifications in livelihood activities and therefore significant changes in rural land use/resources management throughout rural Africa[5], pastoral communities notwithstanding. Marshall (1992) for example, contends that the present day regional variations in subsistence within essentially pastoral cultures did not result from less herd-oriented sub-groups. Instead, they indicate responses to stress on pastoral herds, perhaps

[5] See Bryceson and Jamal, 1997; Bryceson (ed.), 2001; Ellis, 2000

caused by land-use and tenure changes that prevented movement to alternative grazing lands among other factors. Examples abound where changes in the tenure and management of pastoral resources at household, community and state/country levels have resulted to impoverishment and displacement (or marginalisation) of the pastoralists of the East African rangelands[6]. The eviction of pastoralists from several rangeland areas on the basis of their re-definition as Protected Areas (PAs) and the alienation of large tracts of land in the rangelands for commercial/large-scale cultivation projects in Tanzania (MTNRE, 1995; Igoe and Brockington, 1999: Parkipuny 1997), and the privatization and associated sales and leases of pastoral lands as was the case in Kajiado, Kenya (Grandin, 1988; Graham, 1988; Amuyunzu, 1997), have resulted in limited access (by pastoralists) to the range resources; livelihoods diversification due to stress; and have also resulted in the conversion of the rangelands into croplands in different ways, by different people (including the pastoralists) and for different motives.

The above observations suggest that the increasing cultivation in the buffer zones of the East African rangeland protected areas can better be understood in a context of Ellis's (2000) framework for the analysis of rural livelihoods alongside the general theories of land-use change. The framework considers changes occurring in the components that comprise a livelihood, i.e. assets (natural, physical, human, financial and social capital), the activities, and, the access to these (mediated by institutions and social relations). In analysing land-use changes associated with livelihoods diversification in the East African rangelands, the natural assets are

[6] In the context of the buffer zones of the East African rangeland protected areas, this refers to the

hereby translated to mean rangeland resources and livestock, and the activities are mainly pastoralism and the traditional small-scale Maasai cultivation. The institutions that mediate access to the assets and activities (hence determining the living gained from them) are the whole set of conservation and development policies and the associated land tenure on one hand, and the traditional mechanisms of accessing rangeland resources (to include pastures and associated resources, livestock, grain and also land for cultivation) on the other.

The rest of the chapter attempts to put the East African rangelands in the context of Ellis's framework for livelihoods analysis. Specifically, it reviews trends in land-use and pastoral livelihoods in the rangelands, as influenced/mediated by both conservation and development policies operating in the east African rangelands. Emphasis is on the factors behind the increasing cultivation in the rangelands.

2.2 Land-use and livelihoods in the East African Rangelands

Modern archaeological and anthropological studies show East African pastoralists as successfully adapted to their immediate environment and co-existing with wildlife in stable ecosystems[7] (Fratkin, Galvin & Roth, 1994). Contrary to Hardin's 'tragedy of the commons' orthodoxy, their system of resource use, i.e. transhumance, is now understood as reflecting their ecological sensitivity (Niamir-Fuller, 1999; Homewood & Rogers, 1991, Little & Leslie, 1990; Dyson-Hudson, 1980). It is in this context that pastoralism, while providing subsistence to rural populations,

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curtailing of rangelands resulting from conservation and other development policies and projects.

remains an appropriate land use in and around the buffer zone. Livestock is also important in meeting other social obligations of the pastoral communities (Lane, 1996; Potkanski, 1995; Spencer, 1998; Spear, 1993). Therefore, livestock herds ought to be large enough to support subsistence and cultural needs of a growing population (Galvin, 1992). However, pastoralism as a land use and a production system becomes possible if there is room for manoeuverability within the semi-arid environments it dominates.

2.2.1 Pastoralism and livelihoods in the East African Rangelands in history

Pre-modern days' traditional pastoralism appears to have been 'stabilised' in a way by Malthusian checks, but more importantly, by the wide room for maneuverability offered by the then sparsely populated environments. The physical environment with its periodic droughts (and the attendant famines), wars and diseases on one hand, and the pastoral strategy of increasing livestock and family size on the other, tended to create situations of relatively stable growth (in human and livestock population numbers), interrupted by episodes of disasters which decimated the populations significantly (Waller, 1988; Spear & Waller, 1993; Spencer, 1998; Kjekshus, 1977). However, during periods of relative stability, herd re-building took place as livestock increased considerably faster than human populations.

Knowing their environments, the strategies adopted by the pastoralists (as mitigation measures against the seasonal fluctuations and periodic pit-falls in their livelihoods)

[7] Stability is here defined after Holling (1973) - the ability of an ecosystem to return to equilibrium following a disturbance.

are better reflected in the fluidity of their production systems and in the dynamics of their extensive ethnic, social and economic networks described by Waller (1988), Waller and Spear (1993) and Spencer (1998). Briefly, the strategies included spatial movements resulting into expansion of the pastoral territories (and, of course, contraction of others)[8] - a strategy made possible by the then low population densities and lack of legislative rule of law and order. There were also peacefully negotiated movements, administered in the context of social organisations and property rights of the communities involved. These were strategies aimed primarily at gaining access to pastures, and may also involve well defined patterns of transhumance. Some pastoralists are reported to have taken refuge into wetter areas[9] following devastating impoverishment resulting from wars, droughts and diseases (Waller, 1988).

Strategies to ensure food security included food sharing among members of a community, making allies with cultivator communities (for livestock-grain exchange and trade, gifts etc.), pastoral households practising small-scale crop production - with the wealthier pastoralists hiring cultivation labour from cultivator communities. Inter-marriage with women from cultivating communities was also a strategy of obtaining labour for cultivation (Waller, 1988; Spear and Waller, 1993; Gulliver, 1979; Kjekshus, 1977; Spencer, 1998). Also, there are observations of the impoverished pastoralists settling to cultivate in the wetter, arable areas of the

[8] The expansions involved tribal and inter-tribal wars (in order to seize control of grazing lands of specific importance) and cattle raids. The Iloikop wars and the expulsion of Tatoga from Ngorongoro are living examples.
[9] Loita hills, Nguruman escarpment, Ngorongoro highlands, Mts. Kilimanjaro, Meru, Monduli and Baringo and Amboseli swamps are frequently mentioned as drought refuge areas. These areas are

rangelands.[10] This interaction between pastoralists and cultivators may provide insights in explaining the existence of pockets of cultivators within pastoral communities, e.g. those observed in the present-day Serengeti National Park and the Ngorongoro Crater before their designation as protected areas, and in the township of Loliondo (see for example Fosbrooke, 1988; Parkipuny, 1991, Spear and Waller, 1993).

However, the strategies of ensuring access to grain within the rangelands may be looked upon as generating characteristics, which may influence the present-day increasing cultivation. For example, inter-marriages among people of essentially different cultures may, with time, evolve into gradual shifts in the off-springs' cultural orientations, particularly where there is a strong affiliation of sons to mothers as is the case with Maasai pastoral communities[11]. In some places, the hired cultivators established themselves in the pastoral lands to an extent of appropriating large tracts of the rangelands they had converted into crop-lands. Gulliver (1979) for example, describes how a hired Kikuyu cultivator would call in "his extended family and then his entire village." Accordingly, later efforts by the Maasai Local Councils to control the influx of these in-migrants (and, at a later stage, attempts by the central government to remove them) were abortive (Gulliver, 1979). Yet, these settled cultivators undoubtedly required (and cultivated) larger farms for subsistence compared to pastoralists whose cultivation is generally meant

also noted as having formed a focus of competition and conflict between pastoral groups (see for example Waller, 1979).

[10] Loitoktok, Ngong and Mau are wet areas in the east African rangelands where pastoralists have settled as cultivators following episodes of droughts (Gulliver, 1979)

to supplement the pastoral diet. Furthermore, population growth within these pockets of settled cultivators inevitably results in more land being put into cultivation in the absence of other sources of livelihoods. As long as the existing land tenure system allows their expansion, extensification of agriculture into wetter niches of the rangelands will continue with increasing population growth. As a general rule, it is only when there is no room for extensification into new lands (among cultivators) that this pressure is turned in-wards, leading into land fragmentation and adoption of more intensive farming systems - inter- and multi-cropping, adoption of high yielding varieties etc. (Boserup, 1981; Blaikie & Brookfield, 1987). Generally, the features of pastoralism in pre-colonial and colonial periods provided some internal mechanisms of conversion of the rangelands.

2.2.2 Pastoralism and livelihoods in the East African Rangelands today

The present day situation has changed drastically. The general problems that limited population growth in the 18^{th} century have been curtailed by improvements in health care, famine relief measures, as well as governments' control over sporadic tribal and intra-tribal warfares since the turn of this century (Gulliver, 1979; Spencer, 1998). These developments have been effective in reducing mortality, but without a corresponding decline in births[12] among the East African pastoralists (Coast, 2001 & 2002), and the overall population of Tanzania and Kenya. Consequently, population growth has increased drastically in these countries and sub-Saharan Africa in

[11] Maasai women gain command of livestock by bearing sons, and play a major role in choosing/ identifying spouses for them. The chances are that they might prefer seeking their in-laws from their own communities (Spencer, 1998; Laigwanan Nakuroi, Endulen, pers. comm).

general. Projections show a doubling of population in East Africa by the next generation (UNFPA, 1991; Jones, 1991). The overall rapid population growth is envisaged to have affected the pastoral production system from both within and without in diverse ways.

Firstly, because of the overall increase in human populations, the patterns of manoeuverability within the rangelands (pushing into new areas and expanding) are no longer possible. Rather, the emerging trend is that of cultivators tending to push into marginal lands (in this case the rangelands) as pressures on agricultural lands increase.

Secondly, in addition to contracting rangelands, there are now more people in the pastoral communities that are depending on livestock for subsistence. Yet, research provides evidence of fluctuating but not expanding livestock numbers in most of the East African rangelands from 1960's to-date (see for example McCabe, 1993; CSI & FZS, 1997; Homewood, 1992). On one hand, the observed trend of decline in livestock : human population ratios in almost all herding communities in East Africa (Homewood et al., 2001; Potkanski, 1996; Lane, 1996; Little, 1992; McCabe, 1993; Homewood, 1992) ought to be largely due to this differential growth among other factors, rather than a decline in absolute livestock numbers. On the other hand, such declines may result from unfavourable terms of trade between livestock and grain. However, some of the strategies adopted to feed the population in a situation of a declining livestock economy may aggravate the problem (of differential growth

[12] Coast (2001) observed significantly high birth rates leading to a natural increase (NI) of 3.9%

between livestock and human populations), basically because they are strategies driven by need rather than choice (they are distress strategies). For example, Grandin (1988) observed intensive milking (particularly for the poor) among the Olkarkar group ranch (Kajiado, Kenya) as a strategy of obtaining the quantity of milk required for household consumption despite the adverse knock-on effect on calf growth and survival. Cases of sales of lactating cows in the NCA are reported to occur in the early 1990's by Potkanski, (1995) and McCabe, Mollel & Tumaini, (1997) in an environment of exorbitant maize prices disproportionate to the price of steers. Accordingly, maize prices were shooting up because of poor transport systems, and as a consequence, maize not being available on an adequate and secure basis.

The long-term effects of the above coping strategies on herd performance are obvious. Intensive milking for example retards calf growth and maturity, and the sale of milking cows implies less animals milked, more intensive milking, and a smaller proportion of animals that are capable of reproduction. With market prices where grain attains an upper end compared to livestock - a typical situation in periods of prolonged droughts, the consequence befalls the pastoralists. They will have to stretch into unsustainable off-takes, which have adverse effects on herd performance. The compound downward-spiral effect provides an impetus for changes in the pastoral economy. Common changes involve out-migration and diversification of the economy to include adoption of cultivation as a necessary survival strategy (McCabe, 1990). Where adoption of cultivation is the case, and

among Maasai of the SEU.

other factors remaining constant, there ought to be a significant difference in the rate of adoption of these adaptation strategies between the poor and the wealthy pastoralists - the poor being at the forefront. There are however, many examples of wealthier pastoralists in sub-Saharan Africa in general and in East Africa in particular, who diversify into investing in cultivation. As such, the perception of cultivation as a strategy of poor pastoralists (Spencer, 1998; Grandin, 1988) remains questionable in light of the present-day rangelands conversion.

It follows from the above that for the pastoralists to cope in a situation of increasing human numbers, their production system ought to be functional. A functional system demands, among other things, a reasonably large herd (which allows for sustainable off-takes), livestock markets which are effective, and socio-economic environments providing for reasonable terms of trade between livestock and grain (Galaty, 1992; Little, 1984). Yet, reasonably large herds require an environment of proportionate pasture resources and appropriate technical support and development programmes. Thus, the (national) economic development framework and related policies should ensure appropriate integration of the pastoralists system of production as part and parcel of this wider economic system.

2.3 Development policies and the management of pastoral land resources

Macro level policies to redress the overall situation of development requirements in the context of rapidly growing regional populations as well as those focused to pastoralists are argued to have created conditions for rangeland conversion, particularly through changes in the control and management of pastoral resources. These include policies resulting in changes in land tenure, particularly associated with or resulting in alienation of pastoral lands for cultivation (particularly large scale agro-business) or conservation of biodiversity and other uses; as well as conservation policies in themselves and policies encouraging sedentarization and/or land privatization in the rangelands. All these culminate into a net decline in the range resources accessible to pastoralists, and sometimes lead into a break-down of the traditional systems of control over pastoral land resources (Lane, 1996; Ndagala, 1990; Gulliver, 1979; Arhem, 1981).

Historical accounts show that in times of relative social and political stability, particularly before the present-day land tenure regimes associated with colonialism, grazing lands in tropical East Africa were owned and controlled by the herding communities in a territorial context[13] (Ndagala, 1990; Lane, 1996; Spear, 1993; Raikes, 1986; Potkanski 1995). This explains the customary property rights and regimes inherent in the pastoral communities, thus differentiating them from the common property resources usually equated to open access. Gulliver (1979) and Potkanski, (1995) for example, describe how the Maasai are sub-divided into socio-political sections ***(oloshoni)*** in ecologically self-contained localities ***(engutoto)***, each with its own council of elders, and its own permanent water supplies, dry and wet season grazing areas, and rules governing the use of the resources (including strict rules pertaining to the types of animals which are allowed to graze in restricted areas

[13]According to Ndagala (1990), a pastoral territory is an area which includes all spatially dispersed elements for an efficient pastoral production system: an area with important resources of water, salt licks and different types of pasture, and, allowing easy mobility and manoeuvrability should need arise.

such as those designated for calves, sick animals and the old [***olokeri***]). In times of difficulty (e.g. drought) herders have to seek permission of utilising grazing resources owned/controlled by another section, and when allowed, they have to adhere to the use patterns and regulations governing the use of that particular resource.

The importance of territorial control over rangeland resources in a traditional pastoral production system cannot be over-emphasized. According to Behnke et al. (1993), the pastoral territory provides a means to adjust local imbalances in stock numbers and forage availability, and mobility is a production strategy for sustainability of the system. Thus, loss of control over a pastoral territory will not only undermine the pastoral production strategies, but also the status of common property may change into one of open access, and therefore subject to in-migration, degradation and eventually marginalisation of pastoralists. Their consequent impoverishment may, among other causal factors, motivate them to cultivate (in the rangelands) as a survival strategy.

The colonial administration, and later the post-colonial governments political systems and development policies are alleged to have subsumed the traditional community leaders into the superior state authority, thereby compromising their powers to control/regulate communal land use (Lane, 1996; Ndagala, 1990; Little, 1988; Raikes, 1986; Potkanski, 1995). The (incidence of) conversion of the whole ***olokeri*** in the locality of Losilale in the NCA in 1993 (Potkanski, 1995) can be associated with these allegations on the argument that it involved Waarusha cultivators, to whom livestock economy is not as important as cultivation. On the contrary, violation of set rules and regulations over use of pastoral resources is argued to be 'not so controversial' in other areas where agriculture is being practised by people dedicated to the pastoral economy. Maasai cultivation in Pinyinyi (Salei plains) is cited as an example (Potkanski, 1995).

2.3.1 Development Projects

Most of the economic policies affecting land use in the tropical rangelands are influenced by the famous "Tragedy of the Commons" theory (Hardin, 1968). This theory considers the combination of communal ownership of rangelands and individual ownership of cattle as a tragedy because it is theorised that this combination provides an incentive to over-exploit and thus degrade the land. Despite its major weakness (because it did not distinguish between managed common property resource systems and uncontrolled open access), the theory gained support firstly because it supported the earlier convictions of pastoralism as an irrational mode of production incapable of any development (Herskovitz, 1926). Secondly, and perhaps more importantly, because it appeared just before the extended Sahelian drought of the 1970s which resulted in losses of livestock in millions across Africa. The theory, having been interpreted into a model of an in-built mechanism of land degradation in the pastoral mode of production, has given rise to land-use policies and development programmes and projects in the pastoral areas aimed at improving the pastoralists economy and welfare in general (Sandford, 1983; Gulliver, 1979; McCabe, 1990). The development projects were executed mainly through encouraging sedentarization and the commercialization of pastoralists' traditional system of production - changes that have brought their own environmental and social problems, not least because they are based on values alien to traditional, subsistence pastoralism.

While there is considerable reason to conclude that most of these programmes have failed (Morris, 1981; McCabe, 1990), their impact on the traditional pastoral resource control mechanisms may well be interpreted as influencing rangeland conversion. Some development projects are equated with alienation of pastoralists from the rangelands. For example, where the projects involved schemes of livestock development, focus was on commercial production of meat rather than pastoralists' subsistence needs, and such projects were usually established on high potential pastures. The Ruvu ranch in Tanzania is just one example where, according to Ndagala (1974), a total of 44,000 acres were alienated for the extension of the ranch to the dispossession of 276 pastoral households. The households had a total of 7,044 cattle heads, not to mention small stock. In some cases the rangelands were deliberately alienated from the pastoralists and converted into crop-lands. Cases of land alienation for crop production are well documented (see for example Gulliver, 1979; Kjaerby, 1979; Lane, 1996; Igoe and Brockington, 1999). Land alienation implies stress on the pastoral production system, hence impoverishment of the pastoralists.

Land alienation notwithstanding, overall economic development policies are said to favour crop production, based on the views of pastoral lands that are generally under-utilised. There are observations suggesting considerably greater support for cultivated crops through frequently revised prices,[14] availability of inputs and effective market systems compared to livestock development efforts (Parkipuny, 1991). In the same line of argument, developments in economic infrastructure (roads, markets etc.) are said to favour the more settled cultivators (although the logic of this can also be seen in the economies of scale resulting from the high population densities). Worse still, it is generally argued that development policies adopted for the settled, high-density areas have an influence in utilising the adjacent rangelands. Spencer (1998) for example, referring to developments in the Il-Chamus community, contends that developments in the settled cultivator communities (e.g. introduction of ploughs, developments in markets etc.) resulted into increased opportunities for extensive cropping. The outcomes of these developments were displacement of poorer peasants who, in turn, drifted into the marginal, pastoral rangelands. Such lop-sided policies and their unintended knock-on effects may also contribute to the deterioration of the pastoral economy, thus exacerbating conversion of the rangelands.

2.3.2 Land Tenure

The on-going fragmentation of land in the 'group ranches' in Kenya, and the consequent decisions by individuals to sell, lease to cultivators, or cultivate the lands by themselves (Grandin, 1988; Galaty, 1992) stem from the government's land tenure policies which encouraged privatization of the communally owned

[14] In Tanzania, the government generally sets prices of agricultural products. It is only in the 1990's that policies of trade liberalisation started to give way to market forces.

rangelands. The purpose was to incorporate the pastoralists into the mainstream of the national economy; to bring them into commercial livestock production. The strategy was that of encouraging changes in land ownership towards individuals or group of owners (Group Ranches), and by 1980's much of Kenya Maasailand had been partitioned into group ranches (Grandin, 1988; Galaty, 1992). The consequences, however, have been a malfunctioning of traditional pastoral production system as this weakened the communal ownership of pastoral land resources, and later land sub-divisions have resulted in decisions by individuals to sell, lease or cultivate the land they now control. Graham (1988) notes a dramatic polarisation of wealth, which, with the limited territorial movements or shortened transhumance due to privatization, entails marginalisation, and impoverishment of the poor. In general, the outcomes of privatization policy might encourage cultivation as a means of subsistence for the poor, marginalised pastoralists while selling and leasing of land brings in migrant cultivators.

The general thrust of colonial administration was to encourage private ownership of land. This has persisted in post-colonial Kenya (Gulliver, 1979; Amuyunzu, 1997), but in independent Tanzania all land was initially declared state property. Individuals get user rights through customary law[15] or are allocated by the government institutions (Shivji, 1997). However, with the change in political and socio-economic orientation of the country in the early 1990's, symptoms of privatization of land (through individual sales) are emerging, and processes of land

[15] The 1994 Land Act abolished customary land tenure in Tanzania although no one quite knows how to resolve the resulting chaos (Shivji, 1997).

titling are under way[16]. Under such conditions, cultivation in the rangelands may therefore increase as a strategy for acquiring and/or ensuring land rights.

2.3.3 Settlement Schemes

The political move of villagization in Tanzania, adopted after the Arusha Declaration in 1967, and put into force in mid 1970s, is also viewed as having negative effects on the pastoralists' control of their rangelands. The programme aimed at concentrating dispersed rural settlements into manageable population clusters for two main purposes: to facilitate provision of basic social services for the development of the people, and to make administration easier (as the villages were to be administered in smaller units of ten households each). In the pastoral areas, this programme of permanent settlements (commonly known as ***'imparnati'*** among Maasai speakers) was launched in 1974 - 1975 for the purpose of establishing permanently settled livestock development villages in which the basic services for both humans and livestock could be made available (Arhem, 1984; Ndagala, 1992).

Ndagala (1992) and Arhem (1984) associate the settlement scheme with the weakening of the traditional political leadership because it imposed a new, supreme authority structure on the traditional community. Ndagala (1990) equates this to turning the pastoral lands into public land because newcomers no longer sought the permission of the traditional authorities to use the resources but acted on the basis of papers created at the imposed administrative headquarters. Morris (1981) describes

[16] The February 2004 amendments to the 1994 land Act allow ownership of land as private property on the basis of developments made on that land. Cultivation is one such development.

specific impacts in the Kenyan rangelands where in-migrant farmers have been able to monopolise water and other developments of the range and Livestock Development Project funded by USAID. This, and other factors associated with the programme e.g. social services, might also have motivated both sedentarization (hence cultivation) and in-migration, resulting in population clusters of considerable densities atypical to the traditional pastoral system of production. The densities may, on the other hand, provide a nucleus for the development of internal markets for livestock and cultivated products.

2.4 Conservation Policies in the East African Rangelands

Creation of protected areas in the East African rangelands is also associated with impoverishment of the pastoralists due to alienations and restrictions imposed on traditional rangeland management systems. Kjekshus (1977) describes the ecological situation in pre-colonial East Africa as one of a 'conflicting' relationship between wildlife and man; a relationship where man controlled wildlife; a situation of considerably high human population numbers making the present-day protected areas sufficiently populated (with humans and livestock) to have a major effect on the landscape; a situation where only small amounts of wildlife lived alongside them. It is the incidences of 1880 - 1890 (severe famine associated with rinderpest, further compounded by problems of drought and diseases like smallpox), which decimated the human and livestock populations drastically, making the man-controlled ecological system collapse (MTNRE, 1995; Kjekshus, 1977).

Conservation policies came into operation in the 1920's, when the rangelands were sparsely populated.

From this observation it can be concluded that it was the low densities of human and livestock populations which facilitated the establishment of conservation policies currently in vogue - the Yellow stone model of 'parks without people' (Kjekshus, 1977; Enghoff, 1990; MTNRE, 1995). This initial land alienation was not seen as a problem in the conservationists' eyes (except, of course, by those evicted e.g. from Serengeti) because, with the low population densities, range resources were thought to be plentiful (Enghoff, 1990). Today, after recovery from the low densities, a situation of imbalance between population needs and the available resources becomes evident. The mounting conflicts between conservation objectives and peoples' needs which manifest in increasing events of poaching, encroachment of cultivators etc. in the East African PA's and their buffer zones (Kauzeni, 1995; MTNRE, 1995; Mwalyosi, 1992) are indicators of the mounting pressure on resources of the east African rangelands. McNeely et al. (1994) provides substantial evidence of similar, conflicting situations world-wide between increasing human population and conservation objectives. The emerging approach of conservation with human face considers the source of such problems to be rooted in the economic and livelihood benefits of conservation which do not contribute to the welfare of the surrounding communities (MTNRE, 1995; Homewood, Kiwasila & Brockington, 1997; Bell, 1987).

2.5 Cultivation trends in the East African Rangelands

The review above suggests that cultivation in the East African rangelands is increasing in an environment of a multitude of (f)actors, both from within and without the traditional pastoral production system. However, available literature does not take the aspect of cultivation in the framework of pastoral production system. Mostly, available literature revolves around the following: analyses of its role in food security/survival strategy; the relative contraction/loss of range resources resulting from large scale cultivation imposed on the traditional pastoral system through lease/sale of pastoral lands; and, large scale state projects and individual agro-business firms (Graham, 1988; Grandin, 1988; Galaty, 1992; Scoones, 1992; Lane, 1996, 1998; McCabe, 1991, 1997; Parkipuny, 1998, 1995).

With this gap, and, given the envisaged multitude of factors and actors from different socio-economic and cultural backgrounds, an analysis of the emerging types and patterns of cultivation[17] is important in at least two aspects:

(a) Highlighting the possible driving forces, and,

(b) Providing a general idea of the implications (of the emerging cultivation) on the availability of range resources.

From the point of view of farming systems analyses, types and patterns of cultivation may, at a general level, reflect the driving forces. Basically, where

[17] Types and patterns of cultivation are hereby defined to reflect crop type, scale of cultivation, objectives (subsistence or commercial), technology (inputs, tools etc.) and intensity (the whole continuum from shifting through long and short fallow to rotational and multi-cropping levels); and the overall landscape mosaic resulting. Large scale state and individual farms imposed on the

cultivation is subsistence driven, the family size and structure ought to be the main determinants of both the type of crop and acreage per household. Thus, and in line with Chayanov's (1966) hypothesis, acreage per household and output per unit of labour is expected to increase with increasing family size and dependency ratio respectively. Also, where cultivation is profit oriented, agricultural economists have described the influence of markets and market infrastructure on the type and patterns of cultivation in terms of transport costs and distance to the market. Von Thunen's concentric rings theory for example, provide a hypothetical pattern of cultivation whereby cropping intensity decreases with increasing distance to the market (or related infrastructure i.e. roads etc.), and type of crops also change with the same. Accordingly, perishable and/or bulky marketed crop will be located near the markets (and roads). In the same line of argument, deliberate planning based on economic policies or socio-cultural values may result in particular types and patterns of cultivation.

Despite inadequate literature discussing the patterns of cultivation in the East African rangelands, a few observations in light of emerging cultivation in these rangelands are worth a mention. On one hand, McCabe, (1997), Potkanski, (1995) and NCAA/NPW (1995) portrayed the emerging indigenous Maasai cultivation in the NCA as subsistence oriented and small in scale, with an average acreage of 0.25 to 0.5 per sub-household (enkaji). However, no attempt was made to analyse the findings in light of Chayanov's rule, i.e. trying to relate size of farms with family size or available household (or sub-household) labour.

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pastoral lands have generally been associated with loss of dry-season pastures (Scoones, 1992; Lane, As regards spatial patterns, most of the farms/plots were located close to the homestead, thus not interfering with livestock herding. Potkanski further observed adherence of set regulations and rules over the use of land resources among pastoralists in the NCA and in the Salei plains. The regulations and rules were set to ensure that cultivation (in terms of the quality of land it occupies and the layout of farms) was not in conflict with range resources of defined significance or the patterns of herding.

On the other hand, McCabe (1997) and NCAA/NPW report plots of up to four acres cultivated by migrants (and government employees) in some parts of NCA. According to Potkanski (1995), cultivation by non-indigenous may, in some cases, contravene the traditionally set rules over the use of the range resources (section 2.2 above), therefore compromising vital resources for pastoralism. Large-scale agro-business ventures may have more serious effects on these resources because they are imposed on the system with the support of political rather than traditional leaders.

Furthermore, settlement centres with relatively higher population densities, the tourist hotels etc. would logically act as markets and focal points of in-migration. Grainger (1993) for example, contends that land adjacent to new development infrastructure (for example new road developments) will generally attract settlers or squatters, and cites examples of the Amazon basin and the areas of Southeast Asian logging. Cultivation patterns emerging from these populations and residents alike,

1996, 1998), and will not be discussed in this section.

and under the influence of the markets, may result in landscape mosaic very different from what obtains in areas cultivated by the pastoralists. Also, this cultivation may not take into account the range resources required for pastoralism.

2.6 Summary

To this end, it can be argued that the East African buffer zone rangelands are facing a gradual development of a situation of imbalance between population growth and the livestock economy in meeting subsistence and development needs of the people. This imbalance may provide an impetus for the diversification and intensification of production opportunities, including conversion of the rangelands into croplands (on the basis of higher returns per unit of cultivated land). Given that the threat of cultivation in wildlife-livestock areas is on wet-lands, migratory routes and other crucial range resources alongside the general loss of vegetation; that the buffer zones of the East African rangeland protected areas are managed under different (and sometimes conflicting) conservation and development policies; and, in light of the envisaged gradual transition of land-use intensity: Where is most conversion taking place, and with what implications on availability of key range resources?

On the other hand, both conservation and development policies may be creating conditions of stress on the pastoral territory (and therefore on pastoralism as a means of livelihood) in the area. While conservation policies may result in absolute or partial contraction of the pastoral pasture-lands, infrastructural improvements related with the development of the peoples' welfare or the tourist industry, may well result in increases in population densities. Increase in densities is usually associated with integration of populations of different ethnic and cultural backgrounds, and has the potential for markets for cultivated and pastoral products, diffusion of ideas and innovations, as well as other values alien to the traditional production system such as land speculation for individual/private use. Moreover, settlement policies are associated with sedentarisation and provision of social services that may also attract in-migrants. All these may result in increased cultivation in the rangelands. The main question therefore is: How do the different policies influence conversion of the buffer zone rangelands? Focus is on policies related to settlements, in-migration, changing land tenure, regulations or restrictions on the use and/or management of range resources, cultivation, livestock development etc.

Cultivation in the East African buffer zone rangelands may therefore increase as a means of subsistence and poverty alleviation, particularly among the poor, as the capacity of the pastoral system to feed the people declines. Alternatively, and especially where conservation and development policies are not properly co-ordinated, views of the pastoral lands as under-utilised may lead to in-migration of cultivators as well as land use changes based on market influences, prospects for land entitlement or other factors. Also, increase in population densities is associated with development of infrastructure related motives for changing land uses e.g. markets, communication infrastructure etc.

Briefly, key motives of rangeland conversion revolve around impoverishment and subsistence needs, markets and related infrastructure, and the influence of in-migration and land speculation. However, livelihood impacts to the individual, and therefore decisions made to effect changes in land use are not homogeneous. Households with different economic, socio-cultural, ethnic and residential characteristics will be motivated and respond differently to different situations of resources stress or opportunities. Who then are the main actors in the conversion of the rangelands? What are the motives? What are the implications of the increasing cultivation on pastoralism as the main livelihood activity in these rangelands?

Understanding the actors, motives (socio-economic factors) and processes of rangeland conversion will therefore demand household level studies of resource use and livelihood strategies, referenced to different development and conservation policies. The main research questions are:

1. How is cultivation distributed spatially in the buffer zones of the East African rangeland PA's?
2. Who cultivates? Why?
3. How does policy influence cultivation in these buffer zones? (This refers to spatial distribution, actors and factors of cultivation)

Answers to these questions will allow the analysis of the changes as to whether they result from within or without the pastoral system and therefore provide an input to conservation and development policies.

2.7 Hypotheses

This study is guided by the following hypotheses:

1. There is correlation or spatial overlap between land cover change and spatial distribution of cultivation in the East African rangeland buffer zones. Therefore, trends in land cover change associated with human activities (mainly cultivation) will vary between the two zones studied.
2. The magnitude of rangeland conversion (to croplands) varies with conservation and development policies. The variation is observable in size of converted lands, which differ between the two land-use zones.
3. Population sub-groups of different socio-economic and cultural backgrounds living in the study area contribute differently to the conversion of the rangelands. This is manifest in inter-group variations in size of farms, types of crops and in farm management practices.
4. The different population sub-groups are driven by different factors to increase cultivation in the study area. These include:
   - Subsistence needs
   - Access to land resources
   - Development projects
   - Cultivation-biased policies.

CHAPTER 3

THE STUDY AREA: NCA AND LGCA

3.1 Introduction

The study was conducted in Ngorongoro Conservation Area (NCA) and Loliondo Game Controlled Area (LGCA). The NCA and LGCA form the eastern buffer zone of the SEU – the area covered in the overall DFID study, of which this formed part. NCA and LGCA were chosen for this study from the rest of the buffer zones of SEU on the basis that: they represent two distinct land use policy zones within the same ecosystem, with similar habitat types and wildlife populations, and a large proportion of ethnically and culturally similar human populations.

The NCA is a multiple land use area, which allows settlement of pastoral Maasai and livestock keeping alongside wildlife management, but restricts cultivation to hand hoe techniques. Here, land-use is regulated by NCAA staff to suit conservation objectives. Loliondo is a Game Controlled Area (LGCA). Here, all forms of land use are practised, including hunting which is permissible under licence (MTNRE, 1995), and also ox-plough and/or mechanised farming. The two zones provide a suitable environment for natural experiment in analysing conservation and development policy implications on land use, an important aspect of the broader DFID study. Therefore, the factors influencing rangeland conversion to cultivation will be compared between these land use zones of comparable ethnic and cultural contexts but under different conservation and development policies, and at a later stage, with data from Masai-Mara[18] in Kenya.

3.2 Location and Ecology

3.2.1 Geographical location

Ngorongoro Conservation Area (NCA) and Loliondo Game Controlled Area (LGCA) form two of the three divisions of Ngorongoro district, Arusha region (Tanzania). Sale is the third division. While the NCA covers the whole of Ngorongoro division, the LGCA is roughly contiguous with Loliondo division, and encompasses part of Sale division. Thus, the district generally forms the eastern buffer area to the Serengeti National Park (Map 1). It extends to the international Tanzania-Kenya border to the north, and to the east and south it is bounded by Monduli and Karatu districts, all inhabited by agro-pastoral Waarusha and Wambulu, to whom livestock economy is not as important as crop production.

3.2.2 Physiography

The NCA and LGCA are part of the Greater Serengeti ecosystem. However, while Serengeti is generally referred to as 'vast plains' (Fosbrooke, 1988), NCA (and to some extent LGCA) is highly diversified (Homewood & Rogers, 1991; Perkin, 1997; Potkanski, 1995; NLUPC, 1987). Fosbrooke (1998) provides a detailed physiographic description of the area (see Map 2 for relief features and Map 3 for land cover and land use).

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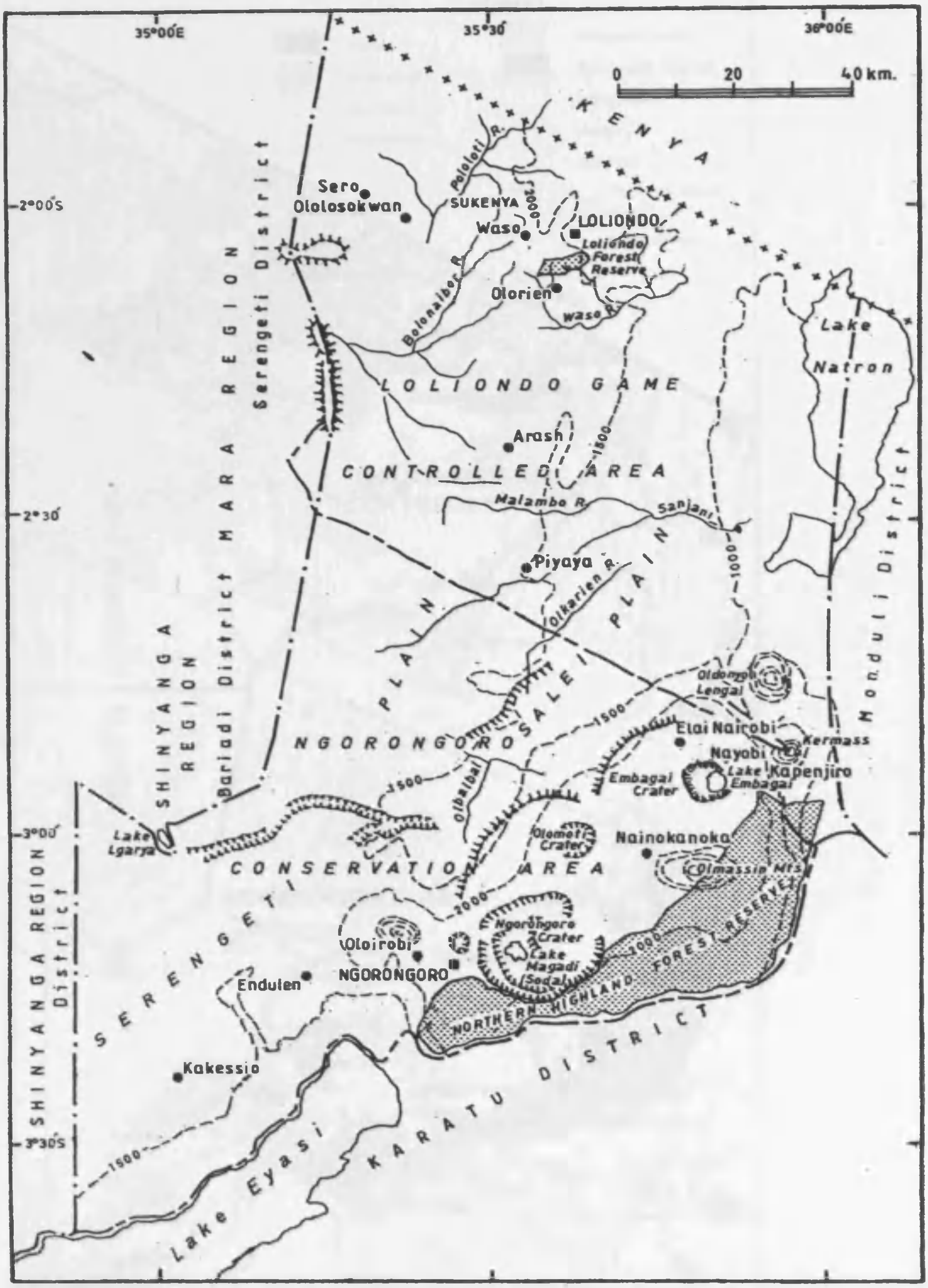
[18] Maasai Mara (in Kenya) provides regional level comparisons in terms of institutional and national land-use policies within similar ethnic and cultural contexts.

MAP 2: NCA AND LGCA: RELIEF FEATURES



MAP 3: NCA AND LGCA - LAND COVER AND LANDUSE

The NCA is generally dominated by the crater highlands in the east, with several depressions (Ngorongoro, Empakaai and Olmoti craters and the Embulbul depression) and peaks (Lolmalasin, Oldeani, Lemagrut, Olosirwa, Nairobi and Kerimasi). Lowland plains dominate the west and southwest, and intermediary slopes between the highlands and lowlands. The Gol Mountains form a rough border to the north of NCA, leaving a narrow corridor (the Salei plain which continues northwards into the LGCA to as far as the Sonjo hills) between them (Gol Mts.) and the eastern highlands. The crater highlands, dominated by montane forests and highland woodland, are important sources of water, with numerous perennial streams. The Gol mountains area is interspersed with short grass plains and bushy slopes with few sources of water (Potkanski, 1995). The western plains are covered with short grass, and have very few, seasonal sources of water.

The LGCA on the other hand is dominated by a centrally situated longitudinal stretch of undulating topography from the broad area of Loliondo highlands (includes Loita, Oldonyosambu and Sonjo hills) in the Kenya border, which narrows southwards through the Piyaya hills to the Gol mountains. The vegetation consists mainly of thicket/wooded grassland interspersed with patches of open grasslands in the north, which develops gradually into wooded bush-land southwards to as far as Piyaya hills. The eastern part comprises of a lowland dominated by Salei plains, to the east of which lies a narrow strip of the East African Rift Valley. The western side constitutes the Angata Kheri plains, which opens up into the broader Serengeti plains. The southern and central parts of the plains are covered by short and medium grass associations extending northwards into the woody vegetations. There are several permanent sources of water (springs and rivers), in the Loliondo highlands. The only permanent water sources are Pinyinyi and the seasonal Olduvai rivers and a few springs in the Malambo area. The rest of the plains area is almost void of permanent water sources, although during the rainy season water is available from several seasonal rivers and open pools.

3.2.3 Climate

Generally, rainfall is the major determinant of primary production upon which cultivated crops and livestock, and hence people's livelihoods are dependent. In the East African rangelands, it is highly variable and unreliable between and within seasons and years, over time and space (Pratt, 1984; Sandford, 1983; Homewood & Rogers, 1991).

These general features are not an exception in NCA and LGCA. Rainfall follows the general east African bi-modal pattern, with short rains in November and December and the long rains from February to May. Averages recorded over a long time, and records of drought periods in the NCA suggest a relatively humid climate compared to that of typical semi-arid areas of east Africa, although periodic droughts are not uncommon.[19]

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[19] Field et.al. (1997) report rainfall statistics 1947-1965 and 1969-1988 which gives mean values of 893 and 898 respectively and which do not indicate any long-term trend for NCA. Homewood &

However, data from different sources (NEMP, 1990, 1991; Arhem, 1981; Homewood and Rogers, 1991; Potkanski, 1995; NLUPC, 1987) describe the area as characterised by significant variations in terms of local patterns. In the highlands, rainfall is more regular and higher than the lowlands. Because of the physiography discussed above and the associated "rain shadow" effect, rainfall decreases in a westwards direction in the NCA, and in the LGCA it increases towards the northwest. Available literature provides averages for the crater highlands to be over 1,000 mm of rainfall per annum. Homewood and Rogers (1991) cites Frame (1976) as having recorded some 1500 mm per annum at Empakaai crater. Arhem (1981) cites Makacha (1980) as having recorded over 1,700 mm per annum for the same place. These values are well beyond those of semi-arid environments, indicating agricultural potentials of the area. In areas around Nainokanoka and Endulen the average is between 800 - 1,000 mm per annum, and this decreases to below 600 mm per annum in the Olbalbal depression and towards the Serengeti plains. Rainfall could be higher in some areas of significantly high altitudes (e.g. Nainokanoka) but sub-alpine temperatures limit forage and crop production.

According to URT (1997), the average annual rainfall in the LGCA ranges from below 600 mm per annum in the eastern lowlands, increasing to between 600 - 800 mm towards the Northwest (Piyaya and Arash) in the period of 1987 - 1996. The North-eastern parts are drier, recording below 600 mm per annum. This

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Rogers (1991) record droughts in four-year periods: 1952-56, 1973-76, and 1981-84,whereas Field et al. (1997) records the same in single years: 1979, 1981 and 1984, which however, fall in the pattern makes irrigation necessary for any cultivated crop production dominant in this (north-eastern) part of the area which is inhabited by the agro-pastoral Batemi. In the Loliondo highlands and the adjacent plateau rainfall averages 1,200 - 1,500 mm per annum, hence defining the area's potentials for agriculture.

Temperature is another important variable that influences both livestock and cultivated crop production. In the study area, this is greatly influenced by the high range in altitude[20] compounded by the complex topography. Despite the lack of up-to-date data, the overall temperatures are shown to range from very hot (up to 38 in January) to very cold conditions in May and June in the highlands (sometimes with frosts at night in the higher areas)[21]. The complex topography results in overall microclimatic variations throughout the study area.

3.2.4 Soils

Generally, the soils of NCA and LGCA are almost similar, with NCA having a higher proportion of volcanic-derived loam and sandy loam soils, and LGCA having a higher proportion of basement-derived sandy loam soils (McMillan and Green, 1982; NLUPC, 1987). Homewood and Rogers (1991) describe the volcanic soils in the area as predominantly of mineral and, in some places, organic fertility considerably higher than those of many African rangelands. They also ascribe the close spatial associations of many different soils (varying in mineral contents) in the NCA to the geological and topographical diversity of the area.

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four-year periods.

Accordingly, this local variation in the mineral content of the soils and the associated vegetation cover influences grazing patterns in the area.

Empirical studies on local variations in the soils of Loliondo are inadequate. However, a survey by McMillan and Green (1982) describes the soils of the northern parts (of Loliondo) as varying with altitude in terms of texture, and classifies the Loliondo/Loita plateau as suitable for cultivation. The same area has been classified as land of high agricultural potential on the basis of farmers' experience (URT, 1997).

3.3 Conservation and socio-economic values

The natural resource endowment described above translates into both conservation and socio-economic values of Ngorongoro district in general, and the NCA and LGCA in particular.

Much has been written about the conservation and socio-economic values of the NCA (see for example, MNRT, 1985; MNRET, 1995; Homewood & Rogers, 1991; Fosbrooke, 1988; Perkin, 1997, Kauzeni, 1995). In addition to its attractive landscape features, the NCA is habitat for large mammals including the highly endangered black rhinoceros; a wet season grazing area for the majority of the Serengeti migratory ungulates; home and production system for over 42,000 resident Maasai pastoralists; a dry-season grazing refuge for neighbouring

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[20] The highest peak (Olosirwa in the NCA) has an altitude of 3680m a.s.l., and the lowest point is Lake Eyasi, 1000m a.s.l.

pastoralists; and, an important water catchment (particularly the crater highlands) for the neighbouring communities. Moreover, the NCA contains unique archaeological and palaeoanthropological resources which include the famous Olduvai Gorge and the Laitole footprints. It is therefore a major tourist attraction in Tanzania. The area is also an outstanding model of multiple-land use practice in the field of conservation. Due to these values, the NCA has been designated a UNESCO World Heritage Site and a Biosphere Reserve (MTNRE, 1995; Perkin, 1997).

LGCA covering 4,000 sq. Km. (Government of Tanzania, 1974), is also of considerable conservation and socio-economic importance in its own right. As well as the resident wildlife, the migratory herds of the SEU move into Loliondo on a seasonal basis. Furthermore, Lake Natron provides the sole breeding site for the Lesser Flamingo in East Africa. By virtue of its traditional conservation-compatible land use, i.e. traditional pastoralism, LGCA not only provides habitat for over 51,000[22] pastoralists and agropastoralists but also increases the range resources (both in area and variety) available to wildlife. Homewood and Rogers (1991) equates the kind of buffer zone offered by LGCA with other unfenced Maasai pastoralists' rangelands around Amboseli and Simanjiro[23]. The CSI and FZS (1997) contends that the area provides a shield between the protected areas (PAs) and those areas of greater densities of people with conservation-incompatible land-use practices such as intensive agriculture. In contrast, they cite

[21] See for example, Homewood and Rogers, 1991; Norton-Griffiths et al, 1975.

the problems of poaching and encroachment into the park boundaries in the western border of the Serengeti National Park (SNP) as related to the dense human populations in the absence of a buffer area. The variety of flora species conserved in the various patches of protected forests including the famous Loliondo trees *(Fagaropsis Angolensis)* from which the name of the area was born sums to an added value. Moreover, the Loliondo hills forms a grazing refuge for pastoralists from neighbouring places in periods of droughts.

The conservation values in the two zones have been preserved for decades in the context of co-existence of wildlife (the critical focal point of conservation in the whole of SEU) and livestock under traditional pastoralism. It is for this reason that Homewood and Rogers (1991) concluded multiple-land use as optimal in the NCA, contrary to the views among traditional conservationists that it was the source of conflicts and related conservation problems.

3.4 Pastoralism, conservation and development

The situation of the NCA and LGCA in terms of pastoral welfare and the prevailing conservation and development policies can be a well placed one in representing the issues discussed in chapter 2. The physical environment (abiotic factors) suggest a rather stable equilibrium with great potential for quick herd restoration (Potkanski, 1995) despite intermittent droughts[24]. However, existing literature and pilot study results on the trends in the welfare of the pastoral

[22] The population of the district as per 2002 census data was 129776; about half of them inhabiting the NCA (URT, 2004)

populations inhabiting the area do not show them as any better when compared to many other pastoral communities in the East African rangelands. A brief review of their situation substantiates this.

3.4.1 Population growth and means of subsistence

The inhabitants of Ngorongoro district are mainly Maasai, comprising approximately 90% of the population. Batemi (Wasonjo), essentially agropastoralists, constitute the remaining 10%, and they inhabit parts of Sale division, leaving the rest of the district to the occupancy of pastoral Maasai. The Maasai are distributed over the area in cultural – cum ethnic sub-groups – Kisongo, Loita, Purko, Laitayok and Salei. However, a few people (other than employees in public/civil service and NGOs) from other tribes have infiltrated into some settlements (Endulen, Nayobi, and Kapenjiro in the NCA, and Wasso Sakala and Loliondo in the LGCA to mention a few). They originate in neighbouring districts and regions, especially Arusha, Mbulu, Karatu, Monduli, Arumeru, Singida and Kilimanjaro. Some of these immigrants are traders and some are engaged in agriculture (URT, 1997; District Planning Officer, Loliondo, pers. comm.).

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[23] Simanjiro rangelands are currently undergoing rapid privatisation and conversion to cultivation
[24] See footnotes 7 and 19

Table 3.1 Population change in Tanzania, NCA and LGCA, 1967 - 2002

Area	Variable	1978	1988	2002	r 1967/78	r 1978/88	r 1988/2002
Tanzania Mainland	Size	17,036,449	22,533,758	33,461,849	3.2%	2.8%	2.9%
	Density	19.33/Km²	25.56/Km²	25.56/Km²			
Arusha Region[25]	Size	926,223	1,350,225	2,333,434	3.9%	3.8%	4.0%
	Density	11.05/Km²	16.42/Km²	29.32/Km²			
Ngorongoro District	Size	47,031	69,107	129776	3.1%	3.9%	4.0%
	Density	3.05/Km²	4.48/Km²	8.41/Km²			
Ngorongoro Division*	Size	19,355	26,894	NA	NA	3.3%	NA
	Density	NA	3.0/Km²	NA			
Loliondo** Division	Size	12,768	21,657	NA	NA	5.4%	NA
	Density	NA	7.5/Km²	NA			
Sale **	Size	14908	20556	NA	NA	3.2%	NA
	Density		5.8/Km²	NA			

* NCA falls wholly in the political boundaries of Ngorongoro division.
** Loliondo division together with parts of Sale division makes the LGCA
(**r** denotes inter-censal growth rate)

In the past three decades, human population figures in both the NCA and LGCA have shown a tremendous increase and significantly high rates compared to the national statistics (see Table 3.1). However, livestock numbers have not increased during this period (McCabe, 1993; Homewood, 1992; Kijazi et al., 1997). As a consequence, there is a gradual decline in Livestock : human population ratios. In the NCA for example, the per capita LU calculated from 1994 figures was 3.37, well below the 1987 figures (6.7 LU/capita) and the estimated 5 LU/capita minimum subsistence herd in an exchange oriented pastoral economy (Kjaerby, 1979) characteristic of NCA and LGCA. The observed increasing tendency towards small stock (Homewood, 1992; Potkanski, 1995; Runyoro, 1993; McCabe, Tumaini & Mollel, 1997) may be indicating people's responses to this stress. In Loliondo, CSI & FZS (1997) observes a similar trend (of declining livestock : human population ratio), but does not provide an account of the strategies adopted for survival. During the pilot study (April-June 1998), small-scale cultivation was observed in all settlement niches accessed, both in the NCA and LGCA. The task of the main study, which commenced in October 1998, was to investigate whether all households were cultivating (the rich and the poor, pastoralists and others alike), and whether those cultivating were doing so for subsistence or other motives.

3.4.2 Development and conservation policies

The developments in specific policies influencing the control and management of the rangeland resources in favour of conservation objectives on one hand, and, on the other, macro level socio-economic policies aiming at improving the peoples' welfare in general, appear to have profound influences on the conversion of the NCA and LGCA rangelands, albeit with a varied magnitude.

In the NCA, conservation policies are associated with the development of conditions of stress on the pastoral production system, hence making pastoral livelihoods difficult. The argument is that, the pastoralists evicted from the PAs lose their grazing territories, and for those living in the PAs, their management of the grazing territory is restricted by conservation management regulations. For example, pastoralists evicted from Serengeti National Park (on its establishment in 1959) lost their territory and re-established themselves in Ngorongoro

[25] Arusha region was split into two regions in 2002: Arusha (r = 4.0%) and Manyara (r = 3.8%). Ngorongoro district is now in Manyara region, but socio-economic relations remain to be highly

Conservation Area (Fosbrooke, 1984), resulting in a net increase in human and livestock populations in a smaller territory (Runyoro, 1993). Furthermore, restrictions on the traditional rangeland management practices e.g. the use of fire[26] or zoning to avoid interaction with wildlife (as a means of avoiding wildlife transmitted diseases such as the Malignant Catarrh Fever [MCF]), and the ban on the traditional small-scale cultivation[27] are problems considered to aggravate declines in the pastoralists' production system (McCabe, 1993; Parkipuny, 1991; Shivji, 1997). Furthermore, the economic returns obtained through tourism accrue not to the people, but to the central government (CSI and FZS, 1997; NLUPC, 1994).[28]

With policies undermining the welfare of the people, the declining capacity of the pastoral system might trigger adoption of other survival strategies, including conversion of the rangelands into cultivation. Expressing their views on livelihood predicaments that result from conservation policies, one of the several NCA residents (pastoral) responding to an interview, portrayed the situation thus:

> *"We don't have enough cattle ... in the past we were fed by our cattle .... and now I must scratch the soil like a guinea-hen to feed the children" (NCA Maasai respondent quoted in Taylor and Johanson, 1997).*

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tied to Arusha region, especially the town of Arusha.

[26] Pastoralists in the African savannas use fire as a tool for managing pastures and parasites Misana, (1989) and Arhem, (1981) noted bush encroachment in several areas of the NCA which they associate with the 1969 ban on use of fire.

[27] Subsistence cultivation, banned in the SNP in 1954, was allowed in the NCA on its creation in 1959. It was banned officially in the NCA in 1975, and lifted temporarily in 1992. The ban has been temporarily lifted due to pressing subsistence requirements of the resident pastoral population, and the law is being reviewed (Shivji, 1997; MTNRE, 1995)

In Loliondo, the influence of policies is rather different. For example, while conservation policy had, until 1992, restricted cultivation in the NCA, Parkipuny (1991) contends that there are, in the administrative/government officials circles, interpretations of pastoral rangelands as under-utilised natural resources:

> *"...there are views of Loliondo as high potential land which is lying idle, future granary for the whole of Tanzania; ....(that) agriculture will open up the area for development - good roads, reliable health services, secondary schools, electricity etc." (Parkipuny, 1991).*

Allocation of large tracts of land to different individuals and commercial firms for crop production (or even other uses) confirms these views. According to the Ngorongoro District Planning Officer, Tanzania Breweries Ltd. (TBL) was allocated 10,000 Ha. in the mid 1980's for barley (though cultivation stopped in 1992), and Tanzania Cattle Products (TCP) was allocated 25,000 Ha. in 1990's (originally meant for cattle ranging but now practising a mixture of activities including tourism). Also, the Otello Business Corporation Ltd. (OBC) owns on contract a 400 sq. Km hunting block. Several other individuals (other than the long-term residents of Loliondo) have been allocated large tracts of land, pending several requests of thousands of hectares awaiting to be approved. This form of land alienation does not benefit the residents of Loliondo, and in some cases, the future of conservation is threatened[29].

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[28] NLUPC (1994) shows NCA as contributing only 16% of the district revenue despite its areal coverage (59%). Livestock contributes about 50% and cultivation about 12%. The rest comes from other sources (not identified).

[29] According to the residents of Ololosokwan village (the location of TCP) TCP occupies an area which is an important animal migratory route. Therefore, development of tourist facilities in the area may interfere with animal migration. Moreover, pastoralists are no longer allowed access to

It appears that conservation and development policies, while varying significantly between the two zones (NCA and LGCA), are associated with contraction of the pastoral lands, thus intensifying the pressure on the pastoral system in the face of the rapidly growing population. In some cases they may be viewed as encouraging in-migration, particularly where the views of 'under-utilised rangelands' exists. The 5.4% human population growth rate between 1978 and 1988 (Table 3.1) can hardly be explained in terms other than in-migration unless we obtain evidence of significant under-reporting or over-reporting in the 1978 and 1988 national censuses respectively. With such discrepancies in policies which influence land use, significant differences may be expected in extent, factors, and actors in rangeland conversion in these areas.

3.5 Socio-economic infrastructure

In the sustainable livelihoods framework (Ellis, 2000), access to the basic livelihood assets is a crucial factor. Access to physical, human, social and financial capital (here denoted as socio-economic infrastructure) are all important in manipulating the natural capital and in determining alternative opportunities and capabilities.

According to NLUPC (1987) and URT (1997) the overall condition of social and economic infrastructure in both NCA and LGCA is poor (see map 4). Except for the single stretch of the regional all-weather road which goes through the NCA

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the permanent water sources and salt licks in the area. The OBC has not quite fulfilled the contractual agreements of providing the villagers with some basic social services - water, roads etc.

and Serengeti National Park (SNP), hence linking the eastern and western regions of northern Tanzania, the rest of the roads are secondary, and in most cases impassable during the rainy season. Loliondo township, which is the administrative headquarters for the district is separated from the main road by an 80 Km seasonal road. In line with the poor roads, only three markets serve the whole district: two in the NCA and one in the LGCA, all operating on a monthly basis. While livestock dipping facilities had recently been improved in the NCA (in implementation of the new management plan), livestock development facilities in the LGCA are generally poor. According to URT (1997) most of the socio-economic problems inherent in the area - lack of acaricides, veterinary drugs, absence of reliable markets for livestock and its related products, the high prices of grain and other commodities, and the lack of investment in tourism to mention a few - are directly related to the poor transport infrastructure.

Despite the national policy of provision of health services and basic education for all, the situation with regards to these services is not appalling. There are two hospitals (one in each zone), and a dispensary in almost every village centre. However, while the two hospitals seem to be over-crowded (as there are no health centres to bridge the hierarchical gap between the hospitals and the dispensaries), the dispensaries in some parts (especially LGCA) did not seem to be under pressure compared to other parts of rural Tanzania.[30] The primary (basic)

[30] During the pilot survey, a few dispensaries visited in the LGCA had drugs at their disposal even in the fourth week of the month. Experience in many rural areas of Tanzania show that drugs in government dispensaries last for approximately 2 weeks.

education sector, while lacking continuity into secondary education,[31] is faced with significant drop-outs of over 50% (see for example McCabe, 1997). Although no proper study exists to explain the apparent under-utilisation of these basic services, the distance factor associated with the layout of pastoral settlements, together with the quality of the primary education provided (which, to some extent, leaves people functionally illiterate) may provide a plausible explanation. All in all, the consequences are a population which is not developed adequately enough to access the variety of opportunities an environment may offer (other than pastoralism and subsistence cultivation). This makes economic diversification an alternative far from reach.

3.6 Landuse and tenure

In general, the control over land resources is administered from different systems at different levels of power/autonomy. These include the conservation oriented government backed authority, the political government institutions, as well as the traditional institutions. The broad land uses resulting are indicated in Table 3.2.

Table 3.2: Broad land uses in the study area

Land Use	Coverage (Km^2)	Proportion (%)
Conservation Area (NCA)	9,104	59
Grazing lands (wildlife & livestock)[32]	4,000	26
Cultivation	500	3
Forest Reserves	948	6
Other uses	878	6
Total	15,430	100

Source: NLUPC, 1994.

[31] The district had, until the end of 1997, a single secondary school. Another one (a day school) opened this year, in the Agro-pastoral Wasonjo (Batemi) locality of Digodigo.
[32] Corresponds to land area covered by the LGCA

In the NCA, the basic land use management plans are vested in the conservation authority, which autonomously define the different land uses in the area to include: residential and livestock/wildlife areas, protected areas, areas for developments of tourist infrastructure etc. To some level, pasture management strategies (among the pastoralists) are influenced by range management approaches of the NCAA. In some areas, land for small-scale cultivation is allocated in 'blocks' by the same authority. The natives therefore control some aspects of land management in their localities as well as pastures within their transhumant movements, in the context of pasture management strategies acceptable to the NCAA.

In the LGCA, conservation influence is mainly observed in the allocation of hunting blocks to firms/individuals, and the overall control over wildlife harvesting and poaching. This leaves the pastoralists with wider choices in range management options. However, land is also controlled by the District Development Council within the political administrative structure of the national government. This central government system controls land use from the district level to as far as the village level, through village councils. As such, large tracts of land in several villages (e.g. Enguserosambu, Wasso and Ololosokwan) have been allocated to private firms and individuals through 'legal' procedures of the government system.

The control of land from the central government system has been the main source of resentments in the study area, even where the villagers appear to have participated in decision-making through their village councils. This is envisaged to continue even with the 2004 amendment of the 2000 Land Act (which vests all decisions over village land use in the village authorities) because village councils are created under the administrative structure of, and answerable to, the central government system. Key informant (KI) discussions with some legal and administrative officials in the district and traditional leaders substantiate this. See Box 3.1.

At individual and small scale land requirements, the village council has the mandate to allocate land for housing construction and small scale cultivation to such individuals on condition that the individual lives or has been accepted to live in the village. This operates in both the NCA and LGCA, and the 2004 amendment of the Land Act does not affect this.

On the other hand, traditional systems of land control aimed at ensuring access to range resources operate in all areas not designated as protected areas. At this general level, the co-existence of traditional rights and systems parallel with the conservation and political administrative authorities results into potential conflicts over rights to land resources.

Box 3.1 Land Tenure Conflicts in the Study Area

KI in LGCA
The village councils may well be used as rubber stamps by the district authorities given the significantly different levels of education and exposure to legislative and policy issues. The case of 25,000 Ha. leased to TCP on villagers' 'consent,' who later complained of the area being bigger than what they had agreed upon (despite their signing for the same land size) is a living example. Probably, they signed without a mental comprehension of how big 25,000 Ha. would be on the ground.

There is pressure to evict Tanzania Breweries Ltd (TBL) from the land leased to them (10000 Ha) in the 1980's. Also, villagers in LGCA in general are not happy with the leased hunting blocks because the promises (of providing social services to the indigenous people) had not been fulfilled. These conflicts have sensitised the indigenous people on control over land resources. At present, most villages are struggling to obtain village land titles (some have already accomplished this).

Researcher
By the time of this research (1999) there was a court case: Ololosokwan villagers against TCP (on the lease of a large tract of land in Ololosokwan village). The villagers lost on grounds of papers they had signed as an agreement. Also, a large meeting of all the people in six villages designated as a hunting block (leased to OBC) was held to discuss the future of the rangelands in light of the on-going leases to outsiders. Some of the resolutions were to reject any new leases and block renewals of the existing ones.

KI in NCA
There is an unresolved conflict concerning the rights to water resources between Sopa Lodge and the villagers in its vicinity.

3.7 Social structure, economy and control over resources

The traditional system of social organisation among Maasai pastoralists in East Africa, and its significance as a framework within which pastoral resources are controlled and accessed (property rights, distribution and sharing) is well described (see for example Spear & Waller, 1993; Grandin, 1991; Homewood & Rogers, 1991; Potkanski, 1995; Coast, 1997). In brief, the system constitutes two structures - spatial and non-spatial organisations. The spatial organisation, when presented in an ascending order, bears the following structure: sub-household (*enkaji*); household/family (*olmarei*); boma (*enkang*); locality/neighbourhood (*engutoto*); section (*oloshoni*), and, Maasai society. Non-spatial organisations have different structures based on clans and age sets. The non-spatial organisations are more important in defining social and economic responsibilities for the community. The two types of organisations are well represented in the NCA and LGCA in the same order, and generally reflect the patterns of control over resources in the literature.

However, the spatial organisation is briefly reviewed here to highlight some aspects of resource control which can accommodate issues related to cultivation, an aspect left out in many studies which focus more on the centrally managed livestock economy. Emphasis is on the smaller units - the sub-household and the family, the boma and the locality. The pilot survey identified them as presenting a hierarchical network of relevance to the understanding of (f)actors in land conversion.

3.7.1 The locality and the boma

Literature shows that the overall control over land use in a locality is a collective decision, arrived at democratically at a locality level (Potkanski, 1995). Thus, land to be cultivated within a locality is also generally determined at this level, mainly as a means of harmonising pastoralism and cultivation, bearing in mind the overlaps in land suitable for crop production and that needed as *olokeri* or critical dry-season pastures. Individuals from different bomas in a locality are therefore expected to cultivate within these agreed-upon lands. In some cases, a cultivable bomas. Furthermore, it was observed during the pilot survey that bomas controlled cultivation lands in their immediate vicinity. This control mechanism within pastoralist settlements may influence individuals' access to land for cultivation, and probably more significantly among in-migrant cultivators.

Plate 3.1 A typical Maasai boma (and its surrounding cultivation plots), Magaidur sub-village of Wasso, LGCA (June 1999)

3.7.2 The household and sub-household

Available literature has widely used the term household as a synonym to (and in some cases in parallel with) the Maasai term *olmarei*. The term 'olmarei' however, does not quite adequately accommodate the UNO (1980) definition of a household. As such, several researchers have used different terms. Spencer (1988) for example, uses the term 'family capitalist enterprise' to reflect the autonomy of the family head in the family livestock. Grandin (1991) uses the autonomy of the family head in the family livestock. Grandin (1991) uses the terms Maasai household and family to mean the primary unit of production, and a centre of livestock ownership that is autonomous in terms of decision-making. This definition concur with that of Coast (2001), in which the term *'olmarei'* denotes an agglomeration of sub-households within a family, headed by an elder, usually the founder of the family[33]. The 'olmarei' has sub-households, (*enkaji* pl. *enkajijik*). These are the wives of the olmarei and their children and other dependants, where each wife is the head of her sub-household.

The olmarei controls livestock centrally and autonomously, basically in terms of off-takes. However, as regards consumption, each wife (head of sub-household/enkaji) is allocated an initial herd for the subsistence of her enkaji and dependants in it. Thus, each wife has the responsibility of managing her own enkaji and the herd allocated to her, as it is from this herd that her sons will obtain bride-wealth and nuclei for their individual herds. In cases of olmarei with large herds, some of the livestock remains in the central pool as 'olmarei livestock'. Lactating cows from this central pool are temporarily allocated to different enkajijik for milking and management of the calves. It is in these contexts that wives control (autonomously) all the milk from the herds that are permanently or temporarily allocated to them, and all the crops they cultivate. Also, it is in the same context that sons may strive to increase the herds in their mothers' control or those allocated to their wives as a means of ensuring a larger herd of their own when the time comes.

[33] See Coast (2001); (2002), for the definitions of Maasai terms related with social organisation.

The fact that individual wives manage their sub-households and the livestock allocated to them interprets into differential wealth distribution up to sub-household level. However, during periods of food shortage the family head is obliged to supply the sub-households with grain, usually through sales of livestock. He may as well opt to cultivate. Where this is the case, labour comes from all the sub-households but he controls all the produce (in most cases grain), and, although it is usually distributed to the sub-households in times of food shortage, he has the right to dispose of it at his will. Implicitly, individual heads of olmarei as well as heads of sub-households may be motivated differently in terms of decisions on cultivation uptake.

Within the olmarei, there may be enkajijik (sub-households) of different categories: those constituting wives of the olmarei, those constituting wives of the sons of the olmarei, and in some occasions, though rare, sub-households of friends of the head of family living in that particular family. In many studies these have been grouped together because the relationships under study focused more on the centrally managed livestock economy. In the context of the study at hand, grouping them may be obscuring because individuals have autonomous control of the products of cultivation, and the lands they cultivate once they have acquired them. Yet, the same individuals' and sub-households' decisions may well be influenced by the higher units - the olmarei, the boma and the enkang. It was for this reason that data on cultivation and livestock were collected from all individuals in the olmarei and collated to form the olmarei data. This also allowed for analyses that reflect individuals' motives for cultivation up-take.

Within the study area there are other people (non-Maasai) who, according to literature, are alleged to participate in the conversion of the rangelands. For them, the term household is appropriate. It is, in this study, used alongside the Maasai term – olmarei to facilitate comparisons between the non-Maasai and Maasai. It follows therefore that, for the sake of comparative analyses, the term 'household' will be used in the thesis to represent both the olmarei for Maasai and the household for non-Maasai.

3.8 Livestock and livelihoods in NCA and LGCA

There is considerable literature showing that livestock in these rangelands can no longer meet subsistence requirements of the population. Most data indicate that the suggested herds of approximately 44 heads of cattle and 100 small stock (Jewell, 1980 cited in McCabe, 1997) so that a pastoral family (of 8 people) can subsist entirely on livestock (diet of 75% milk, 25% meat), or, Harris's 8.7 LE/RA (cited in McCabe, 1997), are rarely achieved. Data of mid 1980's in the NCA (when LE/RA had fallen to 6.8) showed that pastoral diet constituted up to 65% grain (see Homewood & Rogers, 1991). The downward trend in LE/RA has continued unabated in light of a rapidly growing human population. The implication is that there will be a higher percentage of grain in the pastoralists' food. The lack of other sources of grain and the ensuing unsustainable off-takes for the purchase of grain will logically result into cultivation. To determine the extent to which impoverishment of the pastoralists in the study area is driving them to cultivate calls for an investigation into the current state of the livestock economy in terms of herd performance, seeking to quantify off-takes for subsistence as well as available alternatives to grain, cultivation included.

3.9 Summary

The apparent increase in rangeland conversion in both the NCA and LGCA may therefore be influenced by an interplay of factors: impoverishment of pastoralists due to contracting pasture lands and inadequate developments in social and economic infrastructure to promote the pastoral production system and/or its diversification in light of rapid human population growth. Similarly, perceptions of the pastoral rangelands as under-utilised, compounded by the existing (at some levels conflicting) mechanisms of control over land resources, may accelerate rangeland conversion through direct land alienation for cultivation or other uses, as well as encouraging in-migrant land speculators.

As argued earlier, decisions made by individuals in response to conditions of stress or opportunities are largely influenced by the socio-economic characteristics of the decision-makers. The emerging types and patterns of cultivation in the study area are therefore envisaged to reflect, at least to some extent, the characteristics and motives of the actors.

CHAPTER 4

STUDY DESIGN AND METHODOLOGY

4.1 Introduction

This chapter presents the design and methods used in this study. It describes the sample and sampling procedures and the methods and techniques used in data collection and some analytical procedures involved.

4.2 Study structure and sampling

This study examined the factors driving conversion of East African rangelands to cultivation, in a context of conflicting conservation and development policies. It was therefore structured in a natural experiment[34] approach that facilitates comparative analyses between areas of generally similar ecological and cultural backgrounds. This entailed purposeful selection of the study zones, sites and population sub-groups that allow for broad comparisons of rangeland conversion in the light of the influence of different conservation and development policies.

4.2.1 The Study Area

Chapter two presented NCA and LGCA as two areas of generally similar ecological conditions and cultural homogeneity (traditional pastoralism) on one hand, albeit with some localised differences in accessibility (transport infrastructure) and in physical resources such as soils. On the other hand, they are

[34] The term is here used loosely to mean generalised comparisons between and within locations and populations of essentially comparable characteristics.

distinct land use zones subjected to contrasting (and in some cases overlapping or even contradicting) conservation and development strategies and policies. These similarities and differences define the two land-use zones as an ideal case for natural experiment because socio-economic variations between them would then be assumed to result from (or relate with) an inter-play of the conservation and development strategies and policies[35].

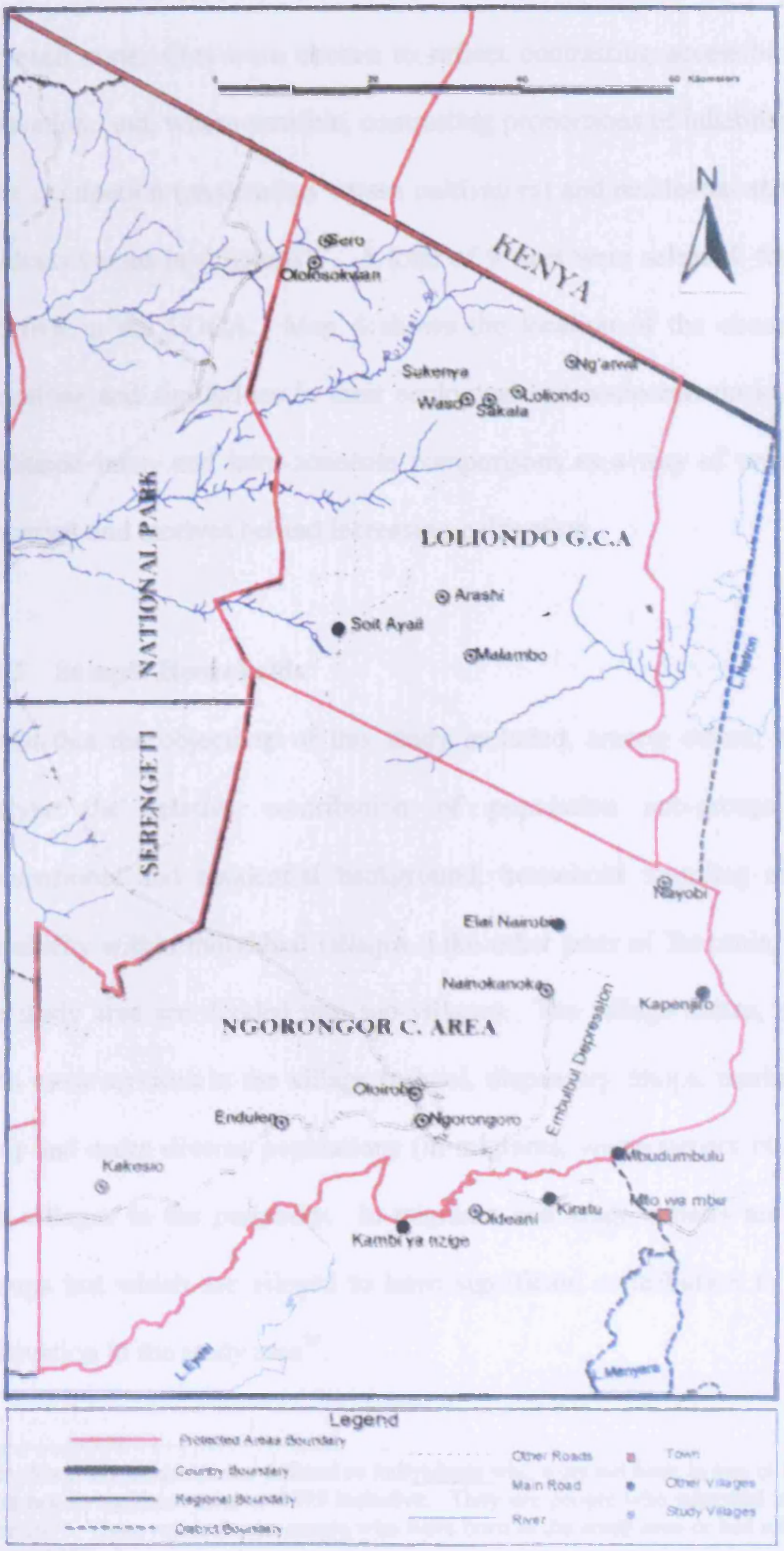
4.2.2 The Study Sites

The study sites were selected to reflect spatial variability, which may influence cultivation. An initial pilot survey of the study area by the researcher had revealed great intra-zone variability in terms of individual settlements' accessibility, history of occupancy and cultivation, land-use patterns and human population characteristics – ethnic, residential and occupational status. The survey involved traversing of almost all settlement niches in NCA and LGCA, followed by PRA and key-informant discussions. The ensuing information (summarised in Appendix 4.1), supplemented by available literature on history of cultivation[36], was used to select study sites considered appropriate for this study.

[35] The potential influence of conservation and development policies in rangelands conversion is discussed in Chapter 2.

[36] Nayobi and Endulen are shown to have had significant cultivation before cultivation ban in NCA, and they were cultivating considerably large farms after cultivation ban (TWCM, 1993; McCabe, 1994; Thompson, 1997). Sakala and Wasso are shown to be cultivation enclaves in LGCA (Parkipuny, 1991).

MAP 4: NCA AND LGCA - STUDY SITES



For each zone, sites were chosen to reflect contrasting accessibility, history of cultivation, and, where possible, contrasting proportions of inhabitants in terms of basic occupation (pastoralists versus cultivators) and residential status (long-term residents versus in-migrants)[37]. A total of 9 sites were selected: four in the NCA and five in the LGCA. Map 4 shows the location of the chosen study sites. Variations and similarities in their ecological and socio-economic characteristics facilitated inter- and intra-zone/site comparisons as a way of understanding the processes and motives behind increasing cultivation

4.2.3 Sample Households

Given that the objectives of this study included, among others, to identify and analyse the relative contribution of population sub-groups of different occupational and residential background, household sampling also considered variability within individual villages. Like other parts of Tanzania, the villages in the study area are divided into sub-villages. The village centre, usually an area with most services in the village (school, dispensary, shops, market, village HQ, etc.) had more diverse populations (in-migrants, wage-earners etc) compared to sub-villages in the periphery. In-migrants and wage earners are minority sub-groups but which are alleged to have significant contribution to the increasing cultivation in the study area[38].

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[37] In this study, migrants are defined as individuals who were not born in any of the two zones and were not living there prior to 1975 inclusive. They are people who migrated into the study area after 1975. Thus, residents are people who were born in the study area or had migrated to the area before 1975.

[38] See for example Mc Cabe, 1994; Thompson, 1997; Parkipuny, 1991.

A sampling strategy, which could capture a reasonable proportion of such minority sub-groups, was used at village level. Two lists of *bomas* – one for *bomas* in the village centre[39] and one for *bomas* in the periphery - were prepared (with the assistance of village leaders). A list of households was shown against each boma. Depending on the number of households per boma[40], a sample of 7 to 15 households was drawn randomly from each of the two lists. The selected households were then collated to make one household sample for the site (the village)[41].

There were few cases (namely Ng'arwa and Arash villages) where the said diversity (among populations) in the village centre relative to those in other sub-villages was not obvious. In such cases, a random sample was drawn from a single list of all bomas in the entire village. Also, there was no clear distinction in populations occupying the village centre and the periphery for Ololosokwan village. However, the village constituted of two distinct sub-villages: The Ololosokwan sub-village with very little cultivation, and the Sero sub-village – a cultivation niche dominated by non-Maasai agropastoralists. A sub-sample was therefore drawn randomly from a list of households in each of the sub-villages and then collated to make the village sample.

[39] All households within 1Km radius were recorded/included in the village centre.
[40] Typical Maasai bomas consisted of more than one household. Non-Maasai bomas consisted of a single household.

The process resulted in the selection of 206 households of different socio-economic characteristics from the selected 9 study sites. Table 4.1 shows the distribution of sample households by their residential and ethnic characteristics. Accordingly, the sample comprises of 72.3% Maasai headed households against 27.7% of non-Maasai, and 77.7% households headed by residents against 22.3% of non-residents. These proportions do not represent population composition of the study area which, together with the non-Maasai residents of the Sale administrative ward, comprises of 90% Maasai, and very few in-migrants. Rather, they are a result of the sampling which was designed to capture a reasonable proportion of these minority population sub-groups.

Table 4.1: Sample Households by Ethnic & Residential Characteristics

Zone	Study site	N	Ethnic category				Residential status			
			Maasai		Non-Maasai		Residents		Migrants	
NCA	Nainokanoka	24	17	70.8	7	29.2	20	83.3	4	16.7
	Endulen	26	19	73.1	7	26.9	21	80.8	5	19.2
	Oloirobi	25	21	84.0	4	16.0	23	92.0	2	8.0
	Nayobi	23	15	65.2	8	34.8	19	82.6	4	17.4
	NCA Total	98	72	73.5	26	26.5	83	84.7	15	15.3
LGCA	Sakala	25	17	68.0	8	32.0	18	72.0	7	28.0
	Wasso	28	11	39.0	17	60.7	11	39.3	17	60.7
	Ng'arwa	20	20	100.0	0	0.0	19	95.0	1	5.0
	Ololosokwan	21	16	76.2	5	23.8	15	71.4	6	28.6
	Arash	14	13	92.9	1	7.1	14	100.0	0	0.0
	LGCA Total	108	77	71.3	31	28.7	77	71.3	31	28.7
Overall		206	149	72.3	57	27.7	160	77.7	46	22.3

This kind of sampling is not representative of the entire population of the study area. Rather, it represents population sub-groups of different socio-economic backgrounds residing in the area. These are residents and migrants, pastoralists and non-pastoralists, Maasai and non-Maasai, etc., alleged to have varied

[41] In Endulen, households headed by members of the Police force are important in the village centre. However, because the lifting of the ban on cultivation precludes civil servants, these

contributions in the conversion of the rangelands to cultivation due to differences in their socio-cultural backgrounds. For this reason, statistical parameters derived from this sample may not be very useful for generalisations over the entire population. They are only meaningful when referring to specific localities, populations and/or occupational sub-groups (e.g. agropastoralists, migrants, wage earners/employees etc.). Nonetheless, the sample serves the purpose of this study - investigating the range of variation and the relative contribution of these different population sub-groups in the conversion of the rangelands, their motives, and how they (the sub-groups) influence each other. Possibilities of having these sub-groups cultivating the rangelands at different scales and with varied motives are discussed in chapter two.

4.2 Data collection

The following primary data were collected for the period of one year (mid-October 1998 to early October 1999).

- Baseline data: socio-economic characteristics of the households (including household demography, residential status, occupation and economic activities of individual respondents)
- Cultivation data: acreage, crops, inputs, distance from markets, roads and homesteads, yields and their disposal
- Livestock data: herd size and structure, births and deaths, off-takes, milk yields and sales, gifts etc.

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households were not included in the Endulen sample (as Police are enforcers of the law).

- Historical data on: occupance of settlements, history of cultivation, and control mechanisms on use and access to land resources.
- Migration (human population): motives and processes of in-migration, means of land acquisition in the study area, etc.
- Markets: types and distribution of markets, goods handled (esp. grain, livestock and livestock products, and crop/livestock production inputs) in different seasons, market prices, etc.
- GPS location of the study sites to obtain remotely sensed data[42] showing land cover change in the area between 1975 and 1995. The change was quantified to assess the amount of human impact and other natural processes on land cover.
- Household economy

Multiple methods from different fields of knowledge were employed in the collection of primary data listed above. The methods, discussed below, include:

Questionnaire surveys,

Formal and informal interviews,

PRA techniques (mainly group discussions),

Participant observations,

Key informant interviews,

Physical measurements or estimations of size of fields and yields,

Market surveys.

4.2.1 Questionnaire surveys

The bulk of household[43] socio-economic data were gathered using structured questionnaires administered to 206 heads of households in the sample, 317 married women as heads of sub-households and 37 other adults in the sample households who were cultivating for own use rather than that of the household. These included relatives and friends of the household heads who lived elsewhere (outside the study site) but sought farms in these bomas[44]. Appendix 4.2 shows the questionnaires and other tools of data collection used in this study.

The researcher administered two rounds of questionnaire interviews, with the assistance of one principle assistant and temporary assistants (one or two depending on the geography and spatial distribution of the households in a study site). The assistants were Maasai whose education ranged from incomplete to complete secondary level, and who were affluent in both Maa and Kiswahili languages. They received a day's on-site and practical training on how to administer the questionnaires. The principle assistant worked with the researcher in all the 9 sites throughout the survey period. This was thought to be useful for consistency in the administration of the questionnaires. The temporary assistants were individuals living in the study sites. In addition to data collection for the two rounds, these resident assistants were important in facilitating easy communication with the heads of households and translation where necessary.

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[42] The University of Louvain provided analyses of remotely sensed data on vegetation and land use change.

[43] A household (***olmarei for Maasai)***, is here defined to mean a man, polygamous or not, with his wife/wives and dependants.

Moreover, their help in the identification of households and individuals (interviewed in the first round) for the second round of interviews was most needed.

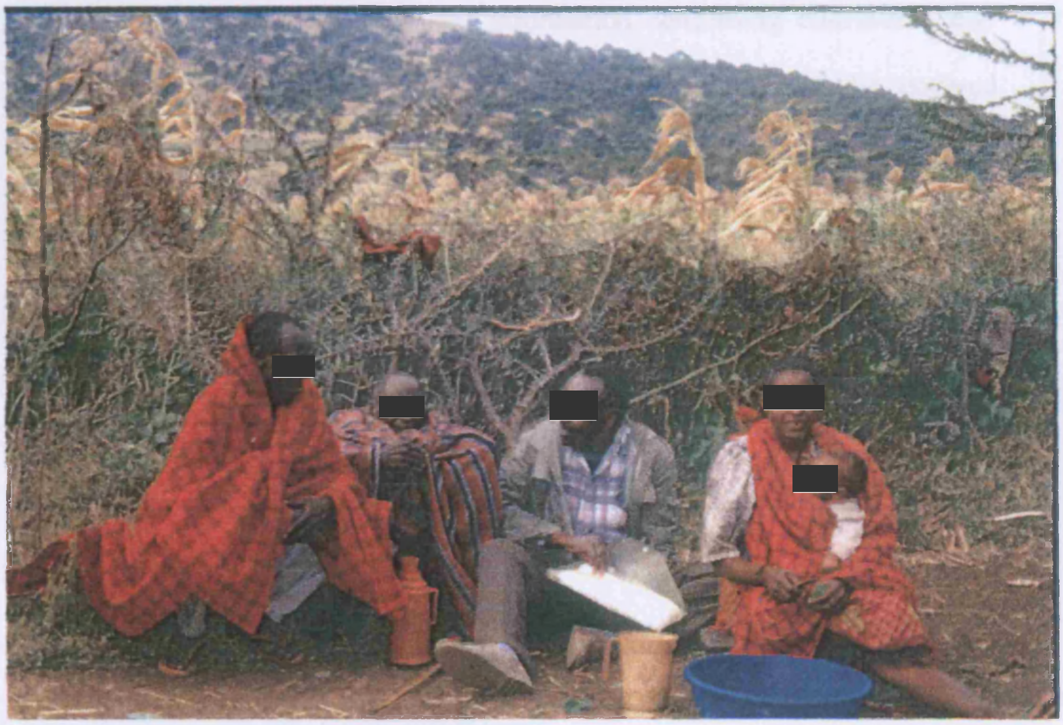

Plate 4.1 The researcher conducting interviews in one of the Maasai households in Nayobi, NCA. (Nov. 1998).

The first round of questionnaire interviews was administered between mid-October 1998 and mid-March, 1999. This is the period of the short rains and the beginning of the long rains. It is the time for land preparation, sowing and weeding of the farms. This round of questionnaire survey generated three sets of basic data:

[44] During the pilot survey, it was realised that there were few individuals in some households who were investing in cultivation for own uses, mainly income generation or herd building. The results of their cultivation were collated with that of the household in the overall analyses.

1. Socio-economic data, i.e. the general demographic and socio-economic data, information on residential status, main occupation (e.g. pastoralism, cultivation, wage employee etc.), livestock ownership, income-generating activities, and whether any form of cultivation was practised.
2. Cultivation: Data covered general information concerning cultivation, e.g. year of starting cultivation, means of land acquisition. It also covered information about previous season's cultivation (1997/98) to include size and location of farms (owned and cultivated plots), type of crops, inputs, yields, disposal, markets and prices etc., and, information on size of farms, type of crops and inputs for the 1998/99 cultivation season.
3. Livestock data: This was confined to herd size and structure, milk yields, availability of livestock inputs, and the general problems facing livestock keepers.

The second round of questionnaire was administered between July and October 1999. This is the harvesting period (for the cultivated crops), and it coincides with the dry season. The survey collected data on the following:

1. Cultivation for the 1998/99 season, covering yields and disposal of the cultivated crops. However, it was realized during this round that obtaining reliable data on the yields for the 1998/99 season was impractical. (See section 4.2.7 below). Therefore, the analyses used yield data for the 1997/98 season, collected in the first round.

2. Livestock, to cover herd size and changes (in herd size) since last visit i.e., time of the first questionnaire interview[45]. The changes included sales and purchases, births, deaths, slaughters, gifts given and received, and livestock exchanged with grain.

The collected information was used in the identification and analysis of actors and motives for the conversion of rangelands. The theory is that decision-making as regards production strategies is influenced by socio-economic characteristics, which include levels of material wealth and/or education, residential status and occupation among others.

Two problems were encountered in the administration of the questionnaires. One was that some households interviewed in the first round were not available for the second round. These were dropped from the sample. The other problem resulted from the nature of information sought by some questions, particularly information concerning in-migration, which is restricted in the NCA. However, the respondents were encouraged to provide the information by the fact that the study had initially been introduced and discussed with the public, and that the questionnaires were administered by, or with the assistance of residents in the study area.

[45] In the first round, respondents were informed of a second round of interviews. They were requested to take note of incidents of livestock change because such information would then be required.

4.2.2 Participatory Rural Appraisal (PRA)

PRA and key-informant interviews (KI) were used in the early stages of this study to construct and detail the history of settlement and cultivation in each study site. Discussions also probed into people's views on the emerging dual mode of production, particularly their perceptions on the motives, importance and associated social and ecological problems. This was thought to provide an important basis for qualitative information to fill in quantitative analyses ensuing, and highlighting the implications for the future of both pastoralism and conservation objectives.

Two formal meetings (scheduled one to four days apart depending on people's other obligations) were held in each village to introduce the study and discuss the above issues. Table 4.2 shows attendance and main issues raised in the meetings.

Participants in the first meeting were the village government officials and traditional elders, and they organised and also participated in the second meeting. Participants in the second meeting were the regular members of the community, although dominated by men in all cases except for Nainokanoka.

Subsequent KI interviews and discussions were conducted throughout the field period to seek information and verifications as need arose. These involved people in different authoritative, expertise and knowledge levels as they were identified during the fieldwork. Plate 4.2 shows the researcher discussing some issues with one of the key informants (KI) in one of the study sites. He is a resident non-Maasai and a member of the village council.

Table 4.2: Attendance and major issues in PRA meetings

Study site	Attendance		Comments on attendance (meeting 2) and major issues in both meetings
	Meeting 1	Meeting 2	
Nainokanoka	11	47	Involved 19 women, mostly members of a women's development group. Concerned about land for the production of cereals. Currently cultivates in neighbouring villages.
CoEndulen	9	73	Mostly men. Issues include: the future of in-migrants into the NCA
Oloirobi	6	22	Mostly men. Concerned about the controlled access to salt licks in the Ngorongoro crater
Nayobi	11	Over 70	About 20 women. Eager about future of cultivation in NCA.
Sakala	8	21	Only three women. Concerned about decreasing size of cultivation land
Wasso	5	32	Generally equal numbers of men and women. Concerned about the increasing distance to cultivable land and crop protection from wildlife and livestock.
Ng'arwa	9	19	Mainly men. Very few women. Happy with the progress they were making in cultivation.
Ololosokwan	8	43	Mainly men. Concerned about village land title deeds
Arash	6	NA	Not conducted; threat of Somali bandits

Plate 4.2: The researcher (left) discussing some issues with a resident non-Maasai KI in front of his non-Maasai house in NCA.

4.2.3 Participatory observation

Data on household economy were gathered through participatory observations that involved direct observations and recalls. The researcher conducted multi-round intensive study on household economy during which data were collected on types and sources of food consumed, as well as different sources of household income and expenditure.

A total of 30 sub-households in 12 olmarei (15 sub-households in each zone) were visited twice during questionnaire surveys and twice when the researcher and the principle assistant were not administering questionnaires. During questionnaire surveys, they could stay and do participatory observations in two to four selected sub-households of one olmarei in a boma for three days consecutively. In this way, each of the selected 15 sub-households in the selected site in a zone were observed for three to four days during each round of questionnaire surveys. The sub-households were visited again for twelve days during breaks in questionnaire administration – six days during the wet season and six during the dry season. This schedule was made possible by the nature of household and sub-household structure described in chapter 3. These visits provided data on household economy for at least 9 days for each sub-household for each season; at least 18 days in total.

4.2.4 Market surveys.

Visits were made to different markets at different seasons of the year. The purpose was to assess availability of foodstuffs (mainly grain) and livestock and crop production inputs. The prices of different foodstuffs, livestock (and livestock products), and related production inputs were recorded. The market data were not only important in the analysis of livestock off-takes as influenced by market prices and availability of grain, but also in establishing other factors influencing production, and which may be linked to motives for cultivation.

4.2.5 Migration study

The researcher held discussions with some of the in-migrants identified during the main phase of questionnaire survey of basic socio-economic data. The approach was one of informal discussion/conversations, normally conducted at leisure times, and without using questionnaires. The main themes revolved around place of origin, cultural occupation of the people in place of origin, the time (year) and purpose of in-migration, how he/she obtained the first (and subsequent) plot/plots for cultivation, and in the case of respondents who were neither heads of households nor their spouses, their relationship with the host or head of household. Data collected in this way were recorded later, and in a rather qualitative form. A total of 18 in-migrants (11 in NCA and 7 in LGCA) were interviewed in this way. Being a qualitative interview, this was sufficient to provide useful insights for the analysis of the motives and processes through which in-migration influence conversion of the rangelands. This approach had been tried during the pilot survey and proved productive[46].

4.2.6 Land Cover Change (LCC)

Human and physical factors in the proximity of cultivated areas as well as the dominant crops were inspected to obtain ideas on whether cultivation (and its patterns) was associated with ecological conditions, ethnicity, residential status, infrastructure and markets (associated with urbanisation and tourism), settlement distribution or other factors. Also, changes in grazing orbits associated with increasing cultivation were discussed and mapped during group meetings with village leaders/elders. The purpose was to obtain some insights on the planning of cultivation and whether it (cultivation) was encroaching on the dry-season pasturelands. As discussed earlier, it is the dry-season grazing areas that fall victim of conversion because of their overlapping potentials (Galaty, 1994) and therefore affecting the grazing orbits and patterns.

Remotely sensed data[47] on land cover change (LCC) was cross-referenced with ground truth analyses and the questionnaire interview data to verify and evaluate the extent of rangeland conversion into cultivation in different areas and periods, and the emerging patterns of land use.

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[46] In the light of controls on in-migration in the NCA, formal interviews would have threatened the interviewees.

[47] Data on LCC was obtained from Louvain University (partners in the wider project), who had analysed LCC in the SEU for the periods of 1975 – 1987 and 1987 – 1995. See Homewood et al. (2001). This study requested extracts of LCC for areas of 5Km radius within the study sites based on GPS locations recorded during questionnaire surveys.

4.2.7 Direct Measurements and counts

The researcher employed physical measurements and counts (on the consent of the respondents) to measure the size of fields, count livestock and quantify crop yields. For cultivated plots, the approach was to inspect the plot after obtaining the proxy acreage from the respondent. This was possible in many areas of maize cultivation because land is usually allocated and labour negotiated by the acre unit. Furthermore, most of the plots stood as rectangular shapes, areal estimates of which were not so difficult to the respondents and the researcher. In case of discrepancies, physical measurements that involved walking the length and width of the plot were employed. (A walking step is also used as a proxy to the yard). In remote localities however, individuals generally practice the slash and burn to transform a piece of land into a field (e.g. in parts of Ololosokwan and Arash). In other areas (e.g. parts of Nainokanoka and Oloirobi) much of the cultivation takes place in old livestock corrals. Most of these had irregular shapes and estimation (of acreage) proved difficult. What the majority of respondents called an acre (with regard to plots of such shapes) eventually ended up as 0.5 acres or even less.[48] Estimates of acreage were therefore obtained after walking the sides/diameters and/or circumferences.

The most difficult part was that of measuring/estimating crop yield. A common unit for measuring crop quantities in Tanzanian communities is the *'debe'* (a large tin, approximately 18 - 20 Kg. of maize), or the sack (5 –6 '*debes*'). For the few

[48] This could explain the high average acreage per household (2.30 acres/household; 1.34 acres/enkaji) resulting from McCabe's interview of 11 respondents in Nainokanoka in 1994 (Thompson, 1997:401).

households that used these units it was easy to obtain data on maize yields. However, these instruments were not commonly used in some of the households except when one was selling, buying, giving out some of the produce, or taking out some for home consumption. This notwithstanding, maize harvested in these households was stored with their cobs, and in structures of diverse shapes. For these reasons physical measurement of yields from cultivated crops was impractical in some of the households. In such cases, yields become known after consumption, i.e. by putting together the consumed amount and that disposed of in various ways. It follows therefore that it was possible (and easier) to obtain generally meaningful estimates of previous year's yields. Because much of the 1998/99 grain yields had not been disposed of, their estimates could not be relied upon. Instead, grain yields of 1997/98 are used in this thesis. This was collected in the first round, a few months after harvest. For vegetable, potatoes and tobacco, the yields used are those of the 1998/99 year. These were available, mainly because they are generally disposed of on harvest.

Another problem area was that of perishable crops that are harvested and consumed or sold on a day-to-day basis, and with no predictable pattern. Potatoes and vegetables produced mainly in Nainokanoka and Oloirobi are the main perishables of concern. However, as much of the potato crop was sold, the respondents could almost correctly estimate yields. What proved difficult was estimating the quantity of harvested vegetables. Luckily, in each of the study sites with considerable vegetable production (Nainokanoka and Oloirobi) I worked with individuals who were contracted suppliers of vegetables to the tourist lodges.

I requested each of them to keep records of vegetables harvested in three households (from whom they bought vegetables) so as to obtain an idea of yields per land unit and income generated.

Livestock counts were done after obtaining estimates from the olmarei. The counting was done in the morning (when livestock go out) or in the evening (livestock coming in). The researcher and the assistants could, in this way, count livestock in three or four households in a day, on the basis of 'one person, one household'.

Two problems were encountered with regard to livestock counts and associated recall data. The first was the commonly reported problem of cases of household heads who were reluctant to allow physical counts of the beasts. This was solved by quick 'eye count' for herds smaller than 30 beasts. For larger herds, the researcher and one or two assistants conducted a quick, simultaneous count in the evening (as large herds tend to come home in a form of a queue). However, very few households (only 2) were reluctant to allow livestock counts, and these were omitted from the sample together with those who were not available for the second round of the count[49].

The second was recall information on deaths since last visit in only a few households, especially those of calves in households with reasonably large herds.

[49] The first round of questionnaire interviews covered 215 households. Only 206 households qualified for the analysis because 9 households were not available for the second round and 2 were reluctant to provide data for the second round.

This was however solved by agglomerating data from sub-households, because, as stated in chapter 3, every enkaji was allocated own herds (and sometimes some from the central pool)[50], where the head of the enkaji was responsible for milking and the care of the calves and sick beasts. The heads of sub-households provided such data with ease, given that they had been requested to keep in mind this kind of information in the first round of questionnaire survey, ready for the second round. Data on deaths and other forms of off-takes as well as herd building for mature livestock was readily available from heads of households and also heads of sub-households.

4.3 Data Analysis

The initial idea was to include in the sample, all the households (olmarei) in a boma so that data from sub-households (enkajijik), other individuals in the sub-household and that of heads of households could be aggregated for both household and boma level analyses. However, some households in the sample bomas were not available for either the first or second round interviews. These were dropped out of the sample, and, for this reason, boma level analyses were not done. Therefore, analyses were based on household as the basic unit of analysis. Where necessary, analysis is done at sub-household or even individual level. Comparisons are made between and within zones, sites and population sub-groups of different socio-economic characteristics. In the presentation however, the terms 'household' and 'sub-household' are used in place of olmarei and enkajijik for easier communication and comparisons between Maasai and non-Maasai

[50] See chapter 3 section 3.7.2.

households in the study area (for which the terms olmarei and enkaji are not appropriate. See chapter 3).

The bulk of socio-economic data, cultivation, livestock and household economy was managed and analysed using the SPSS, and presented in tabular and graphical forms. Variations and similarities were compared between and within zones, study sites and population sub-groups of different socio-economic characteristics. This information was used to examine the distribution of cultivation in the study area spatially and within and between population sub-groups.

Data on livestock performance were analysed in light of the scientific model of sustainable livestock production modified to suit east African pastoralism (Potkanski, 1995)[51]. Focus was on the proportion of off-takes for subsistence (sales, slaughters and grain loans and exchange) against that of purchases from different sources, including cultivated crop. This was compared between and within zones and livestock-wealth sub-groups in the examination of the factors behind cultivation-up-take among pastoralists.

Qualitative information from PRA meetings, KI interviews and other sources (archival documents) was analysed in terms of content. This is presented in text, tables, boxes and plates.

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[51] The modelled rates of sustainable off-take for east African pastoralists assumes off-takes of between 8 and 10% under conditions of a natural increase of 5% per annum (see Potkanski, 1995).

CHAPTER 5

SPATIAL DISTRIBUTION OF CULTIVATION IN THE NCA AND LGCA

5.1 Introduction

Conversion of rangelands into cultivation is generally associated with declines in vegetation cover. Specifically, it is linked with diminishing dry-season grazing lands, which fall victim to cultivation. In the context of development needs for a rapidly growing human population[52], cultivation may mean more yields per unit of land in these rangelands. But, in light of the values for which PA's are created and the generally fragile rangeland ecosystems, it may lead into declines in the functioning of the rangeland ecosystem, suggesting a potential loss of pastoral livelihoods.

This chapter examines the extent of conversion of rangelands into croplands in NCA and LGCA. It compares the extent of cultivation up-take between and within the two land-use zones and relates its spatial distribution with patterns of land-cover change in the area. It uses remotely sensed data to analyse land cover change and survey data to examine and explain spatial distribution of cultivation in NCA and LGCA. Moreover, it analyses the determinants of spatial distribution

[52] Population growth rate was significantly higher in the study area (5.4% in the LGCA, 3.9% in the NCA) compared to that of the country (2.8%) recorded in the 1988 population census (URT, 1992). The 2002 census shows a growth rate of 3.9% in the study area and 2.9% for the country.

of cultivation with an attempt to link cultivation and associated land cover change (LCC) with some conservation and development policies/strategies in the area. Specific questions addressed include:

1. Where is most cultivation taking place? Is there correlation/overlap in the distribution (location) of cultivation and the patterns of land-cover change? The main variables in this analysis are proportions of cultivating households, size of household farms and land cultivated in 1997/98 season in locations of varied accessibility and ecological conditions.
2. What are the factors influencing spatial distribution of cultivation in the area?

The chapter is divided into four parts. The first part examines and compares trends in land cover change in the area. Land cover change analysed here is that which can be linked with conservation and development policies, i.e. change associated with human impact and natural succession. The second part presents and compares data on the extent/magnitude of uptake and spatial distribution of cultivation in the area, with an attempt to link rangeland conversion (to cultivation) with LCC. The third part examines the factors influencing spatial distribution of cultivation, and the last is a short summary.

5.2 Land-cover change (LCC) in the study area.

Remotely sensed data[53] covering the period of 1975-1995 suggest that land cover change in the study area was generally stable and relatively low compared to other

PAs in the Tanzanian part of the SEU where human habitation is restricted, as well as other areas of conservation with development in the Kenyan part of the SEU, i.e. the inner and outer GRs around MMNR. Both NCA and LGCA registered a 2.65% overall change in the 1975-1995 period (Table 5.1a). Other areas in the SEU registered higher levels of LCC, e.g. MGR (19.3%), SNP (5.16%), and areas surrounding MMNR (between 10.3% and 18.3%). See appendix 5.1

There are however, some important variations in the distribution and direction of land cover change in the study area. These are observed as hot spots of significant LCC in some settled areas, increasing in magnitude in areas close to established cultivation, particularly in the eastern and southern boundaries of NCA. (See appendix 5.2 for LCC Map). Variations are also observed in change associated with natural succession (i.e. increasing vegetation cover) in areas subjected to specific conservation policies or those formerly under human impact but are currently without human interference.

Change associated with human impact (HI) is higher than change associated with natural succession (INC) in both zones (HI = 1.77%; INC = 0.68%), though it remains generally low. Change associated with human impact is slightly higher in NCA (1.86%) than in LGCA (1.67%). However, LGCA registered a four-fold increase in this type of change in the 1987/95 period (from 0.32% in 1975/87 to 1.35% in 1987/95) compared to the decline from 1.30% in 1975/87 to 0.56% in

[53] Source: Louvain University (partners in the wider project - Savanna Land Use Policy Outcomes).

1987/95 in the NCA. The patterns in change associated with natural succession correspond to the patterns observed in change associated with human impact.

These patterns of land cover change may point to the varied influences of conservation and development policies in the two zones. The overall higher levels of change associated with human impact in settled areas compared to when we consider the whole area reflects the impacts of villagisation policy of 1975/1976. Declines in change associated with human impact in NCA coincides with cultivation ban in 1975, which was however, not fully effected[54]. In the LGCA, increase in change associated with human impact concurs with the period when development strategies included encouragement of cultivation in the area, and with the forces of economic liberalisation policies.

Table 5.1a Land-cover change (%) in NCA & LGCA, 1975 - 1995

Zone	Total area (Ha)	% with data	HI 75-87	HI 87-95	INC 75-87	INC 87-95	Change 1975-95
NCA	820456	91	1.30	0.56	0.29	0.20	2.65
LGCA	729207	87	0.32	1.35	0.78	0.14	2.65
TOTAL	1549663	89	0.85	0.92	0.51	0.17	2.64

Key:

- HI = Change associated with human impact; a decline in vegetation cover
- INC = Change associated with natural succession; increase in vegetation cover

[54]TWCM, 1993 observes that cultivation was effectively prohibited in the area until 1977/78, but surfaced again in 1981. A 1987 report (Makacha and Ole Sayalel, 1987) indicated that unlawful cultivation was being carried out in the area on a substantial basis.

Table 5.1b presents LCC data for individual study sites for the purpose of comparing the two zones in terms of settled areas. The overall change in this context is also very low. However, it is slightly higher (3.6% in NCA and 3.3% in LGCA) than when considering the whole area (2.65% in both NCA and LGCA). Moreover, change associated with natural succession in these settled areas is negligible (0.4% in NCA and 0.5% in LGCA) when compared with change associated with human impact (3.4% in NCA and 2.7% in LGCA). Human impact is therefore the main contributor in the overall change. Therefore, LCC observed in settled areas is generally a reflection of the localised impacts of human and livestock populations.

Table 5.1b LCC 1975 - 1995 in study sites as % of area with data

Zone	Site	HI		INC		CHANGE		OVERALL
		1975-87	1987-95	1975-87	1987-95	1975-87	1987-95	1975 - 95
NCA	Nainokanoka	0.6	0.1	0.0	0.1	0.6	0.2	0.8
	Endulen	1.8	1.8	0.3	0.1	2.1	1.8	3.9
	Oloirobi	0.7	2.4	0.0	0.0	0.7	2.4	3.1
	Nayobi	3.6	5.7	0.0	1.9	3.6	7.6	11.2
NCA total		1.4	2.0	0.1	0.3	1.4	2.3	3.7
LGCA	Waso/Sakala	0.4	2.5	0.7	0.1	1.1	2.6	3.7
	Ololosokwan	0.9	0.1	0.3	0.2	1.1	0.3	1.4
	Arash	0.0	3.7	0.6	0.0	0.6	3.7	4.3
	TBL farm	0.0	3.3	0.3	0.0	0.3	3.3	3.6
LGCA total		0.3	2.4	0.4	0.1	0.8	2.5	3.3

Key: HI: Change associated with human impact (a decline in vegetation cover)
INC: Change associated with natural succession; increase in vegetation cover
CHANGE: Total change in each period
OVERALL: Total change for the entire period (1975 – 1995)

There are some important inter-site variations and similarities in the magnitude and direction of change within and between zones. Nayobi and Endulen in NCA and Wasso, Sakala and Arash[55] in the LGCA registered high levels of change associated with human impact. Nayobi[56] registered the highest change of this type for the entire period (9.3%), as well as for the period of 1987 - 1995 (5.7%) and therefore the highest overall change (11.2%). On the other hand, Ololosokwan in the LGCA and Nainokanoka in the NCA registered very little change associated with human impact (1.0% and 0.7% respectively) compared with the rest of the sites.

With regard to the direction of change, there was high increase in change associated with human impact between the two periods in Oloirobi (from 0.7% to 2.4%), in Nayobi (from 3.6% to 5.7%) and in Arash (from 0.0% to 3.7%). There was also an increase in natural succession in Nayobi (from 0.0% to 1.9%). On the other hand, Nainokanoka in the NCA and Ololosokwan in the LGCA registered slight decrease in change associated with human impact (from 0.6% to 0.1% and from 0.9% to 0.1% respectively) while Endulen registered no change of this type.

In general, the above analysis shows very little change in vegetation cover in the Tanzanian part of the SEU, except for Nayobi. However, two observations in the above patterns of LCC are useful in linking declines in vegetation with the conversion of rangelands to cultivation: One is the observation that, LCC is higher when we consider settled areas alone instead of the whole area. The other is that

[55] Settlement and cultivation data do not support this high rate of change associated with human impact in Arash. However, the area accommodates large herds of livestock, including those belonging to well-to-do pastoralists residing in the more accessible areas. This high level of change can therefore be associated with the livestock numbers.

the dominant type of LCC in settled areas is that associated with human impact. These observations signify the impacts of human activities on vegetation cover. Therefore, if the distribution of cultivation will match the patterns of LCC, then cultivation will be the main culprit for the observed vegetation declines in these rangelands.

Site variations in the magnitude of LCC in the NCA generally concur with TWCM's results of aerial survey on spatial distribution of cultivation in the area in 1993, where areas of Nayobi/Kapenjiro and Endulen had the largest amount of cultivated land, followed by the slopes of Olmoti crater around Nainokanoka and in Oloirobi (TWCM, 1993). This pattern may have changed following the lift on cultivation ban in 1992. Moreover, we are lacking similar data for the LGCA, and no systematic field/ground-work has been done to link the observed declines in vegetation cover with the increasing cultivation in these rangelands. The next section attempts to fill this gap.

5.3 Cultivation up-take

Spatial distribution of cultivation was analysed by comparing the extent of cultivation up-take by sample households in locations of different characteristics in the study area. Proportions of cultivating households and the size of land converted to cultivation in the sample were compared between and within zones and study sites, and the findings cross-referenced with the information on land cover change (section 5.2). These variables were further analysed in relation to

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[56] Nayobi, in the eastern boundary, is inhabited mainly by agro-pastoral Waarusha.

spatial factors and conservation and development policies assumed to influence spatial variations in the intensity of rangeland conversion. The purpose was to identify areas with most cultivation, and associated spatial factors. The relative contribution of population sub-groups defined by their socio-economic characteristics (e.g. ethnicity, residential status, wealth, etc.) is dealt with in Chapter 6. Therefore, the data at this stage is not disaggregated by such characteristics.

5.3.1 Cultivating households

Information on involvement in cultivation was obtained through questionnaires and physical checking of the cultivated land. A household was considered to be involved in cultivation if any of its sub-households (or any member of any of its sub-households) owned and/or cultivated land area of at least 100 square metres.

Of the 206 households interviewed, 188 (91.3%) were cultivating (Table 5.2a). This is a high rate of cultivation uptake in an area of livestock and wildlife management designated as buffer zone to the SEU core PA. Contrary to our assumption[57], the proportion of sample households that are involved in cultivation was relatively higher in NCA than in LGCA (95.7% and 87.0% respectively).

Table 5.2a Cultivating households in the sample (by zone)

Zone		Cultivating	Not cultivating	Total
NCA	Count	94	4	98
	% within Zone	95.9	4.1	100.0
LGCA	Count	94	14	108
	% within Zone	87.0	13.0	100.0
Total	Count	188	18	206
	% within Zone	91.3	8.7	100.0

Results of cultivation up-take in individual study sites showed considerable inter-site variation in LGCA, but not in the NCA (Table 5.2b). In the NCA almost all of the sample households (between 88% and 100%) were involved in cultivation. Only four households (one non-Maasai household in Endulen, two non-Maasai and one Maasai households in Oloirobi) were not cultivating. Discussions with heads of the non-cultivating households showed that three were in-migrant traders/shopkeepers and one was a Maasai employee of the NCAA. According to the conditions on which the ban on cultivation was lifted in 1992, these in-migrants had been allowed residence in the NCA (because of the nature of their occupation), but not cultivation. Further discussions revealed that they were not cultivating in fear of jeopardising their jobs/business and residence in the NCA given the easy accessibility of these sites to the NCAA HQ. If these households were excluded from the sample, then all (100%) of the sample households in the NCA would be cultivating.

[57] The assumption was that, despite the more favourable ecological conditions in the NCA, the LGCA would have more households involved in cultivation than NCA because of the differences in conservation and development philosophy in the two zones.

Table 5.2b Distribution of households by cultivation up-take and study site

Zone	Study site	Cultivating		Not cultivating		Total
		No	%	No	%	(N)
NCA	Nainokanoka	24	100.0	0	0.0	24
	Endulen	25	96.2	1	3.8	26
	Oloirobi	22	88.0	3	12.0	25
	Nayobi	23	100.0	0	0.0	23
	NCA Total	94	95.9	4	4.1	98
LGCA	Sakala	25	100.0	0	0.0	25
	Wasso	27	96.4	1	3.6	28
	Ng'arwa	20	100.0	0	0.0	20
	Ololosokwan	14	66.7	7	33.3	21
	Arash	8	57.1	6	42.9	14
	LGCA Total	94	87.0	14	13.0	108
Study area (Overall)		188	91.3	18	8.7	206

In the LGCA the scene is different. Involvement in cultivation varied considerably, with some sites having only 57% of their sample households involved in cultivation, and some having up to 100%. Three sites had almost all (between 96% and 100%) of the households in the sample involved in cultivation, irrespective of their ethnicity. These were sites surrounding the agricultural niche/settlement of Loliondo town-ship. The remaining two sites (Arash and Ololosokwan) had between 57% and 67% of the sample households involved in cultivation. Majority of the non-cultivating sample households in these two sites belonged to Maasai, whereas all non-Maasai households in these two sites were cultivating.

A variation in proportions of involvement in cultivation, as observed in the LGCA, was not unexpected in a rangeland zone open to 'development'.

Generally, the varying proportions of cultivation up-take may be associated with ecological conditions, variations in the occupational culture of the people, existence of some niches with a long history of cultivation etc. (C.f. section 2.2.1 of chapter 2). It is also a reflection of the degree of livelihood choices available to the people in the area. On the other hand, the homogeneity observed in the NCA may be an indicator of lack of livelihood choices among the people resulting from conservation regulations rather than homogeneity in the natural environment[58].

5.3.2 Land converted to cultivation

The main variables used to analyse spatial variations in the magnitude of conversion of rangelands into farmlands are household farmlands and current cultivation. The term 'household farmland' is here used to connote land that has been converted to farmland. It includes all fields that are currently cultivated and fields that are on short term fallow, i.e. they were cultivated at least once after the 1992/93 season. It also includes farms under long-term fallow, i.e. those fields that had not been cultivated at all after the 1992/93 season but are still considered as household property)[59]. Current cultivation is used to connote all land that was under cultivation in the 1997/98 and 1998/99 seasons (the time when the fieldwork for this study was conducted). It includes fields that were under short-term fallow (cultivated at least once after the 1992/93 season).

[58] Natural, political and socio-cultural conditions influence livelihood choices available and consequently, diversity in households' economic activities.
[59] Through interviews and physical inspection of farms, it was noted that some households in LGCA had permanently fallowed considerably large tracts of land since 1992/93 following the cessation of barley cultivation. Other fields are fallowed irregularly due to a wide range of reasons (e.g. bad weather, labour constraints etc.).

Except where stated, the analysis of current cultivation is based on data for the 1997/98 season. This is because the total amount of land cultivated in the 1998/99 season was affected by the late on-set of the rains, such that a considerable proportion of the cultivating households could not cultivate all the fields intended. Also, yield data for this season could not be obtained for most of the households (see chapter 3). It should also be noted that excessive rains (*El Nino*) in the 1997/98 season hampered proper management of the fields, such that some or parts of the fields were not harvested. Therefore, land cultivated in the 1997/98 season refers to the sum of acres that were cultivated and harvested and acres that were cultivated but not harvested. Yields are however referenced to acres that were cultivated and harvested only.

5.3.2.1 Household farmland

This section examines the spatial distribution of cultivation in the study area for the purpose of identifying areas where much of the rangelands are being converted into croplands. It does not at this stage disaggregate the data by ethnicity and other factors like residence, wealth, etc. (this is dealt with in Chapter 6). Rather, it analyses pooled means in terms of size (acres) of farms and land cultivated in the sample households in the 1997/98 season. Table 5.3a shows mean size and medians for land converted to cultivation in the study.

Table 5.3a Size of household farms (acres) by zone and study site

Zone	Study site	N	Mean	Std. Deviation	Median
NCA	Nainokanoka	24	1.5000	2.2688	1.0000
	Endulen	26	2.8269	1.9644	2.0000
	Oloirobi	25	1.7860	2.5868	1.0000
	Nayobi	23	3.2326	1.8272	3.5000
NCA TOTAL		98	2.3316	2.2659	1.5000
LGCA	Sakala	25	5.6600	3.9999	4.5000
	Wasso	28	5.5714	6.3690	3.0000
	Ng'arwa	20	4.1625	2.4092	3.7500
	Ololosokwan	21	1.8095	1.7064	1.2500
	Arash	14	1.1464	1.2596	.6500
LGCA TOTAL		108	4.0259	4.3467	2.7500
OVERALL		206	3.2199	3.6070	2.0000

The overall average farmland per household was 3.2 acres; median 2.0 acres. This is generally small compared to other agro-pastoral communities elsewhere in Tanzania[60] but it stands as an important indicator of the degree of rangelands conversion in the area.

Cross-zone comparisons (Table 5.3b) show that LGCA had a higher average of land converted to cultivation (household farmland) compared to NCA. The difference is statistically significant (mean 4.02 and 2.36 acres respectively; $t = -3.598$; $p < 0.001$).

[60] Schuller, (1984) observed that 54.7% of households in settled agro-pastoral communities in Mwanza and Shinyanga (Tanzania) owned and cultivated farms of between 3.1 and 5.0 acres. These communities are also polygynous, with an average of 1.3 wives per household (Chimile, 1994). The average number of wives per household in the study area was 2.3

Table 5.3b T-test statistics: Magnitude of cultivation by zone

Variable	Zone	N	Mean	Std. Deviation	T	p-value
Household farm	NCA	98	2.3622	2.2127	-3.598	0.000
	LGCA	108	4.0259	4.3291		

A one-way analysis of variance showed a significant variation in size of household farmland within the study sites (Table 5.3c). Accordingly, the difference was significant within the overall study area (p = 0.000); within sites in the NCA (p = 0.001), and within sites in the LGCA (p = 0.001).

Table 5.3c: ANOVA: Household farmland compared between study sites

		Sum of Squares	df	Mean Square	F	Sig.
Study Area (Overall)	Between Groups	549.830	8	68.729	6.395	.000
	Within Groups	2117.289	197	10.748		
	Total	2667.118	205			
NCA	Between Groups	53.834	3	17.945	6.066	.001
	Within Groups	278.058	94	2.958		
	Total	331.892	97			
LGCA	Between Groups	353.250	4	88.313	5.452	.001
	Within Groups	1668.367	103	16.198		
	Total	2021.617	107			

A post-hoc test (Scheffe test) to identify sites with statistically significant variations in size of household farms was carried out. The results showed some note-worthy inter-site variations and similarities between and within the two zones. Accordingly, Nayobi and Endulen in the NCA, and Sakala, Wasso and Ng'arwa in the LGCA own relatively large farms, without a statistically significant difference between them (medians between 2.0 and 4.5 acres). On the other hand, Nainokanoka and Oloirobi in the NCA, and Arash and Ololosokwan in the LGCA have small farms of generally comparable size (medians $\leq$ 1.25 acres). The difference between sites with small acreage and those with relatively larger acreage was statistically significant ($p < 0.05$).

Significant inter-site variations within the NCA were not expected because of the homogeneity of the population and the land use policies operating in this area. However, the LGCA, significant inter-site variations could be expected because the majority of the people in Sakala and Wasso are basically cultivators, whereas in Ololosokwan and Arash they are predominantly pastoralists. However, the same sites (Arash and Ololosokwan) show significantly smaller farms when compared to Ng'arwa, which is also a pastoral settlement. Moreover, the size of household farms in Ng'arwa compares almost equally with those of Sakala/Wasso). Possible explanations for these variations (and similarities) will be teased out in later chapters.

5.3.2.2 Fallow land

Considerable proportions of the household farmlands were under fallow during the time of the fieldwork. Overall, the average land under fallow during the 1997/98 season was 0.95 acres per household in the sample households. The distribution was highly skewed, with LGCA registering a high mean of 1.47 acres per household compared to 0.36 acres per household in the NCA. The difference is statistically significant ($t = -3.692$, $p < 0.001$). This significant difference is partly attributed to cultivation ban in the NCA, as it needs a considerable period of time before households could open farms large enough to allow deliberate fallowing. LGCA households in this case are assumed to have accumulated large farms over time. Moreover, the opening up of Loliondo division for cultivation in the mid 1980's brought in prospective cultivators who initially cultivated large farms, but the harsh climatic conditions have discouraged them, resulting in fallowing. Currently there are indications that the fallowing may continue indefinitely in some farms, and others are being abandoned[61].

5.3.3 Cultivation and land cover change

The higher means in land converted to farms in the LGCA correspond to the observed trends in land cover change (LCC) in the 1987/95 period, particularly that associated with human impacts (Table 5.1a). That NCA has lower means is more or less a reflection of the effects of the cultivation ban[62] among other factors, and this may be associated with the observed patterns of vegetation change in the area.

Moreover, there is a considerable inter-site variation in land converted to cultivation in terms of size of household farms, and that of land currently under cultivation. These spatial patterns concur with the patterns of land cover change discussed in section 5.2 above i.e. areas with high levels of land cover change

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[61] Interviews with the District Agricultural Officer, Chairman and other KI pointed to possibilities that these fallow farms may be re-converted to rangelands in the near future because: 1), The majority of in-migrants who came into the district during the hey-days of barley and acquired and cultivated large tracts of land had left the district, abandoning the farms. 2), Some residents are gradually turning the abandoned and their own fallowed barley farms into pasture lands.

[62] Lifting the ban on cultivation in 1992 means that they started cultivation in the 1992/93 season, and household acreage will be increasing gradually over time.

have also registered high means in land converted to cultivation and vice versa. Tests of correlation (Table 5.4) supported this congruency.

In short, concordance of the patterns of land converted to cultivation with the patterns of vegetation decline, particularly those associated with human activities may be a reflection of the influence of different policies over time and space. This is discussed in Chapter 7.

Table 5.4 Correlation between LCC and Mean household farms

Zone	Study site	N	Household farmland (acres)	% of LCC (5Km radius)	Comments
NCA	Nainokanoka	24	1.50	0.8	Low cultivation, low LCC
	Endulen	26	2.88	3.9	High cultivation, high LCC
	Oloirobi	25	1.80	3.1	Low cultivation, high LCC
	Nayobi	23	3.29	11.2	High cultivat. v. high LCC
	NCA Total	98	2.36	3.7	High cultivation, high LCC
LGCA	Sakala	25	5.66	3.7	High cultivation, high LCC
	Wasso	28	5.57	3.7	High cultivation, high LCC
	Ng'arwa	20	4.16	No data	
	Ololosokwan	21	1.81	1.4	Low cultivation, low LCC
	Arash	14	1.15	4.3	Low cultivation, high LCC[63]
	LGCA Total	108	4.02	3.3	High cultivation, high LCC

5.4 Current cultivation.

Current cultivation refers to the state of cultivation in the study area as it was during the time of the fieldwork. It includes all the land that was cultivated in the 1997/98 season, irrespective of whether it was planted and/or harvested, but excludes all the land that was under fallow during the time of the survey. Table 5.5 compares land that was cultivated in the 1997/98 season by zone and study sites.

Table 5.5 Cultivated land (1997/98) by zone and study site

Zone	Study site	N	Mean	Std. Deviation	Median
NCA	Nainokanoka	24	1.2479	1.5421	1.0000
	Endulen	26	2.5000	1.8398	2.0000
	Oloirobi	25	1.3060	1.6590	1.0000
	Nayobi	23	2.9717	1.8176	3.1000
NCA Total		98	1.9995	1.8497	1.5000
LGCA	Sakala	25	3.6800	2.6036	2.5000
	Wasso	28	2.9643	2.4718	2.0000
	Ng'arwa	20	3.3375	1.7886	2.7500
	Ololosokwan	21	.8571	.9506	.5000
	Arash	14	1.1464	1.2596	.6500
LGCA Total		108	2.5537	2.2959	2.0000
	Overall	206	2.2900	2.1089	1.7500

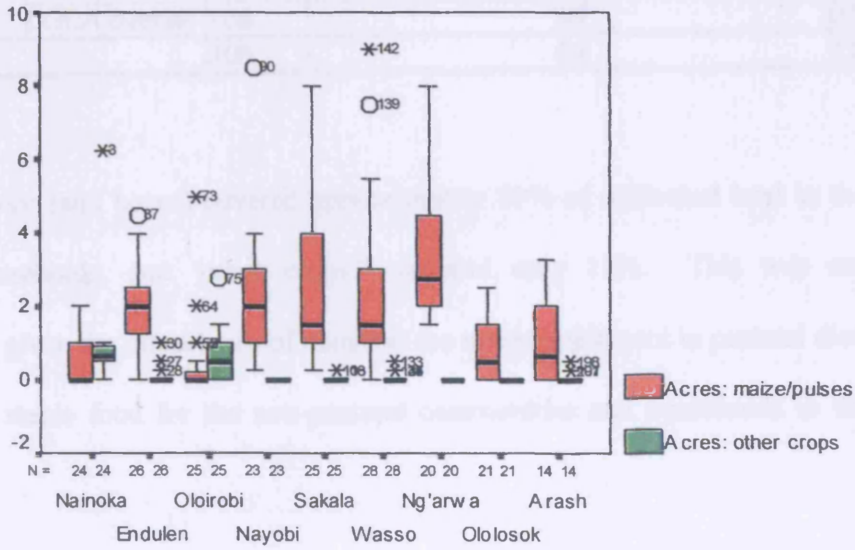
The overall average household cultivation was 2.29; median 1.75 acres. This is generally small compared to other agro-pastoral communities outside the rangelands (see footnote 62). LGCA had a generally higher mean of land cultivated in the 1997/98 season compared to NCA. The difference was not significant ($t = -1.952$; $p = 0.052$). This may be explained by the discrepancy between household farmland and land that was cultivated in the 1997/98 season in the LGCA because LGCA households had considerably large proportions of their farms that were under long fallow. NCA households owned smaller farms and had very little under fallow. Therefore, the observed inter-site variations are more or less a reflection of variations in the size of household farmland rather than land cultivated in the 1997/98 season.

[63] High LCC in Arash was concluded to result from the impact of livestock rather than cultivation. The area harbours large numbers of livestock.

5.4.1 Cultivated crops

Transect walks, physical inspection of fields and interviews produced a long list of cultivated crops[64] in the study area. Fields of maize and pulses (mostly beans) dominated the landscape in many of the study sites. In Nainokanoka and Oloirobi however, a landscape mossaic of patchy fields planted with a variety of vegetable species, potatoes, maize, and, to a lesser extent tobacco, was observed. There were also observations of some crops cultivated in very small quantities, i.e. very small land area (patches), or, very few plants distributed randomly in fields of other crops, and in some cases standing as single plants. These were bananas, pumpkins, simsim, fruit-trees, etc[65]. Figure 4.2 shows the relative distribution of maize/pulses against other crops by site.

Fig. 4.2 Acres for different crops



[64] See appendix 5.2

[65] Crops cultivated in very small quantities are not included in this analysis. Crops included are those cultivated in fields measuring at least 100 Square metres (10 * 10 long strides). These are maize, beans, potatoes, vegetables and tobacco.

5.4.2 Spatial distribution of cultivated crops

In addition to ecological determinism, the spatial distribution of the different types of cultivated crops is envisaged to vary with some socio-economic factors. Table 5.6 presents and compares the distribution of different crops with respect to land cultivated in the 1997/98 season.

Table 5.6 Distribution of cultivated crops in land cultivated in 1997/98 season

Zone	Village	N	% cultivated land with maize & pulses/hh	% cultivated land with other crops/hh
NCA	Nainokanoka	24	30	70
	Endulen	26	97	03
	Oloirobi	25	42	58
	Nayobi	23	100	00
	NCA overall	98	76	23
LGCA	Sakala	25	99	01
	Wasso	28	97	03
	Ng'arwa	20	100	00
	Ololosokwan	21	100	00
	Arash	14	94	06
	LGCA overall	108	99	07
Overall		206	89	11

Overall, maize (and beans) covered approximately 89% of cultivated land in the sample households, and 'other crops'[66] covered only 11%. This was not unexpected given the importance of maize as the main supplement in pastoral diet, and as the staple food for the non-pastoral communities and households in the study area.

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[66] In this study, 'other crops' is used to denote potatoes, vegetable and tobacco.

There is a significant difference in the proportion of land planted with different crops between the two zones. The amount of land planted with maize (and pulses) is smaller in the NCA compared to that in the LGCA (76% and 99% respectively). The difference results from the small amount of land planted with the crop in two NCA sites – Oloirobi and Nainokanoka. It is therefore attributed to ecological limitations because most of the respondents in the sample households in the two sites said they would prefer to cultivate maize but they had no land that is suitable for the crop[67]. Instead, they planted their fields with potatoes, vegetables and tobacco, which thrive well in these areas and sell them to purchase grain. Some of the potato is consumed at home, but it is not a favoured substitute for maize. Much of it is sold to purchase grain and other household requirements. Sopa Lodge (a tourist hotel in the NCA) and Karatu township provides market for the crop. The growing of crops that are not really favoured may be an indication of the influence of markets.

There is a higher proportion of land planted with 'other crops' in the NCA compared to LGCA. The low adoption of 'other crops' in LGCA is however, not sufficiently explained by ecological limitations because field observations showed that these 'other crops' could thrive fairly well in several other sites (with different ecological conditions) e.g. Ng'arwa, Sakala and Wasso) in the LGCA, and also in Endulen in NCA. The influence of markets may explain the high adoption of

[67] Several households cultivated maize in fields in neighbouring villages (Olbalbal, Sendui and Alaililai).

other crops in the NCA sites in general terms, i.e. Oloirobi and Nainokanoka[68]. However, the same factor does not sufficiently explain the extremely low levels of 'other crops' in the three sites in LGCA as they surround Loliondo township and the new administrative HQ which are a potential market, even though not comparable to tourist hotels in the NCA. Similarly, market potential does not explain the differences between Nainokanoka and Oloirobi in the NCA (Nainokanoka has higher proportion of cultivated land and households with other crops compared to Oloirobi. Yet, Oloirobi stands a better chance in terms of potential markets. These discrepancies in adoption of 'other crops' suggest that spatial factors alone may be inadequate in explaining land-use change. Rather, non-spatial factors ought to be considered alongside the spatial factors. These are teased out in chapter 6.

5.4.3 Cropping patterns

Inter-cropping and multiple cropping were the only cropping patterns observed or reported, and at a generally low scale. Patterns of inter-cropping were those of maize and pulses on one hand, and potatoes and vegetables on the other. In most fields maize was standing as a single crop. In a few cases, maize was inter-cropped with beans, and in even fewer cases, beans stood as a single crop. Potatoes, vegetables and tobacco were commonly cultivated in old (evacuated) *bomas* or cattle sheds. In some cases, each of these crops could stand as a single

[68] Nainokanoka has one tourist hotel (Sopa Lodge), situated approximately 6Km south of the village, and Oloirobi has several such hotels (Rhino, Serena, etc.), These, and the NCAA HQ, are potential markets for vegetables, and to some extent, potatoes. Much of the potato crop is sold in Karatu, a small town some 46 Km from Nainokanoka, 28Km from Oloirobi.

crop in a small field. However, it was a common practice to partition the fields and plant each plot with a separate crop. With vegetables, smaller plots with a variety of vegetable species in one field were common practice. Tobacco stood as a single crop, except in a few cases where very small patches were observed in isolation within fields planted with other crops. This pattern of inter-cropping was common in all sites across the zones[69]. Plates 5.1 and 5.2 illustrate a comparison of cropping patterns between the two zones.

There were three levels of cropping intensity. These are: Irregular cropping, where some households cultivate only in bad years[70], observed in Ololosokwan and Arash in LGCA; annual cropping, observed in all other sites in both NCA and LGCA; and multiple cropping observed only in vegetable fields in Nainokanoka and Oloirobi in NCA. The latter however, depended on availability of water and markets, allowing between two and three crops in a year. Irregular cropping in Ololosokwan was, in most cases, linked with shifting cultivation[71]. These patterns are indicative of differential effects of settlement and cultivation on land cover change, and also the different degrees of importance that cultivation may be accorded by different population sub-groups depending on the different motives (discussed in chapter 6).

[69] Because of intercropping, analysis of acreage based on single crop is not possible. Therefore, acreage for maize and pulses are pooled together, and that of potatoes, vegetable and tobacco are combined as 'other crops'.
[70] According to pastoralists in the study area, a bad year is one accompanied with problems like drought and livestock diseases.

Plate 5.1 Crop patterns in LGCA: Maize standing as a single crop

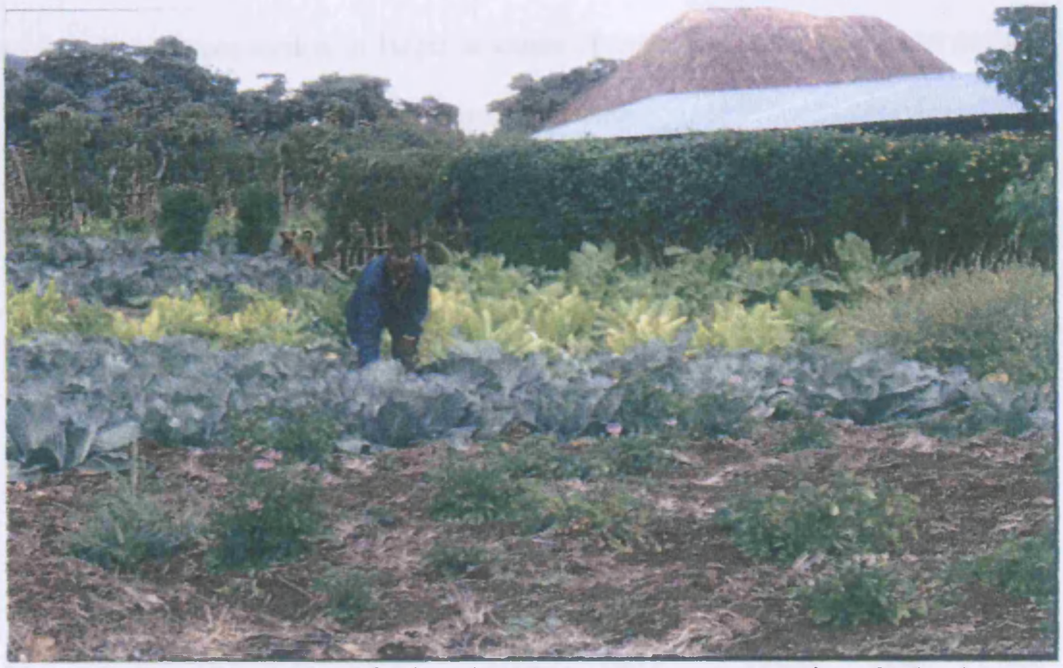

Plate 5.2 Crop patterns in Nainokanoka, NCA: Numerous crops in a single plot

[71] Shifting cultivation leads to more land cleared of vegetation whenever a household abandons a farm and begins a new one. It is a common practice in villages without adequate evidence of permanency in settlement (e.g. permanent houses), a typical case in Ololosokwan and Arash.

5.4.4 Yields and disposal

Yields for maize and pulses were compared between the two zones for the 1997/98 season (Table 5.7). Generally, the yields were low in both zones. NCA had lower yields compared to LGCA. The main reason for these low yields was the adverse weather conditions for that particular season, particularly in the NCA where yields were specifically lowered by extreme weather conditions in Nayobi, an area usually considered productive.

Data from district files showed a slightly higher yield (1200Kg per hectare) for the period of 1986 – 1995, but this is also a low figure. These low yields are a reflection of the low level of farming technology among other things, and may have led to the conversion of larger amounts of rangelands to croplands to meet food requirements for the growing human population.

Table 5.7: Maize and pulses yields in the study sites (Mean & Median Kg/household)

Zone	Village	N	Total Kg. harvested	Std. Dev.	Median	Yield in Kg/acre	Std. Dev.
NCA	Nainokanoka	8	540	335	475	440	184
	Endulen	25	1020	547	900	510	111
	Oloirobi	8	750	768	425	600	255
	Nayobi	23	880	734	900	410	180
	NCA total	64	880	636	700	480	175
LGCA	Sakala	25	1390	940	1200	670	238
	Wasso	27	1560	1690	1100	620	294
	Ng'arwa	20	2300	1374	1725	690	136
	Ololosokwan	14	620	377	750	370	211
	Arash	8	720	423	925	390	133
	LGCA total	94	1450	1321	1125	590	255
	Overall	158	1234.156	1061.234	955	536	214

The mean yields are consistent in three sites – Sakala, Wasso and Ng'arwa – with yield per acre falling within the average figures for Arusha region and the national figures over ten years (1981/82 to 1991/92)[72], but lower in the other two sites. This difference could be attributed to variations in rainfall in that year, and probably to other factors like labour and other inputs.

5.5 Determinants of spatial distribution (location) of cultivation

In addition to different land-use policy zones, the study sites were selected to reflect a wide range of spatial variables: agro-ecological conditions, distance from established cultivators, access to roads/markets and history of cultivation, but in a generally comparable pattern between the two zones. The assumption was that cultivation up-take would be influenced in one way or another by these variables, and result in some predictable and comparable spatial patterns observable in the proportion of households taking up cultivation and the average size of land converted to cultivation per household. Land-use zones (defined by conservation and development policies) would explain much of the spatial patterns/variations in the study sites under conditions of 'generally similar spatial characteristics'. In this context, comparisons of sites in LGCA (comparable to those in NCA) would result in LGCA sites registering higher levels of cultivation up-take. There would be fewer households involved in cultivation and even smaller farms in NCA compared to LGCA despite the comparable influence of these spatial variables.

[72] See Ministry of Agriculture and Cooperatives (1996).

However, the patterns observed in this study with regard to the proportion of households involved in cultivation and also the mean size of converted lands in individual sites are not sufficiently explained by zone. LSD analyses of variance on land cultivated in the 1997/98 season (summarised in Table 5.8) show that cross-site differences and/or similarities exist irrespective of the land-use zone. There are sites with generally comparable levels of cultivation (high acreage of medians of 2.0 or more acres per household, and low acreage of medians below 1.5 acres) in both LGCA and NCA despite the generally comparable (or otherwise) spatial factors.

Table 5.8 Sites with high and low acreage (1997/98 cultivation)

Sites with:	Site	Mean acres	Std. Deviation	Median	Zone
High acreage	Sakala	3.7	2.6036	4.50	LGCA
	Ng'arwa	3.3	1.7886	3.75	LGCA
	Nayobi	3.0	1.7848	3.50	NCA
	Wasso	3.0	2.4718	3.00	LGCA
	Endulen	2.4	1.4461	2.00	NCA
Low acreage	Oloirobi	1.3	1.6506	1.00	NCA
	Nainokanoka	1.2	1.5421	1.00	NCA
	Arash	1.1	1.2596	0.65	LGCA
	Ololosokwan	0.9	0.9605	1.25	LGCA

These irregularities suggest the importance of the other factors in explaining spatial variability in the up-take of cultivation. This section explores the influence of these other factors in general, and between the two zones. The analysis however, does not include proportions of cultivating households in the NCA because almost all households in this zone (96%) were found to be cultivating. Moreover, it is focussed only on current cultivation so as to reflect the current situation.

5.5.1 Effects of ecological conditions

The general ecology of the area is discussed in chapter 3. In this study, spatial variability associated with ecological constraints was manifest in different aspects like climate and soils, local ecological land-use zoning and the resultant location of farms, and, constraints associated with the presence of wildlife in the area.

5.5.1.1 Climate and soils

The study sites were classified into three broad ecological zones on the basis of climate and soil conditions (see Chapter 3). These are highland areas with low temperatures (Nainokanoka and Oloirobi in the NCA); areas of moderate climate (Endulen and Nayobi in the NCA, and Wasso, Sakala and Ng'arwa in the LGCA); areas of low rainfall (Arash in the LGCA); and, transitional areas having between moderate and low rainfall (Ololosokwan in the LGCA). See Appendix 5.3 for details of this classification. Table 5.9 presents the distribution of cultivated land within these ecological zones.

Table 5.9: Acres cultivated 1997/98 by climatic zones

		Acres cultivated 1997/98			
Zone	Ecological zone	N	Mean	Std. Dev.	Median
NCA	Highlands, low temp.	49	1.3	1.5823	1.0000
	Good/moderate climate	49	2.7	1.6313	2.2500
	Total	98	2.0	1.7473	1.5000
LGCA	Moderate climate	73	3.3	2.3429	2.5000
	Transition (moderate/low)	21	0.9	0.9506	0.5000
	Low rainfall	14	1.1	1.2596	0.6500
	Total	108	2.6	2.2959	2.0000
Overall	Highlands, low temp.	49	1.3	1.5823	1.0000
	Good/moderate climate	122	3.1	2.1009	2.5000
	Transition (moderate/low)	21	0.9	0.9506	0.5000
	Low rainfall	14	1.1	1.2596	0.6500
	Total	206	2.3	2.0674	1.7500

Generally, cultivation is practised in areas of good to moderate rainfall. In this study, such areas registered higher acreage (median 2.5 acres) compared to areas of low rainfall (median 0.65 acres). The northern Highlands in NCA register very little cultivation (1.29 acres per household; median 1.0 acres) because, despite the reasonably high amount of rainfall, the low temperatures and the overall soil conditions do not favour maize crop. Instead, potatoes and vegetables are grown in small plots (in most cases old cattle bomas) near homesteads. The majority of the respondents would prefer to cultivate maize but the major constraint was availability of land suitable for the crop.

Households in the zone of transition have substantially little land under cultivation although the climatic conditions are not that bad[73]. The generally comparable low acreage in the zone of transition and the highlands suggest that in the zones of transition, climatic conditions are important when decision to cultivate has been made, but may not necessarily be a factor of decision to cultivate in the rangelands.

5.5.1.2 Local land-use zoning, location and availability of farmland

Local ecology-based land-use zoning influence the availability of cultivable niches and consequently the distribution of cultivation within areas of generally similar ecological conditions. Two levels of localised ecological zoning were observed in the study area. One is zoning done locally at ***engutoto*** level, where niches of

[73] The site (Ololosokwan) is endowed with some cultivable niches (particularly in Sero sub-village) cultivated mainly by few in-migrants of the late 1970's. They claim to have occupied and

significant values to the inhabitants of the ***engutoto*** (e.g. ***olokeri*** which is commonly managed), is delineated from other uses, particularly cultivation. NCAA in the NCA does the other level of ecological zoning, where blocks for cultivation were zoned parallel to other forms of controlled land-uses. In this context, areas zoned as cultivation blocks are those considered suitable for the purpose but whose locations (in terms of basic resources) were not in conflict with conservation interests.

In some settlements, land for some particular crops is limited. In the case of Nainokanoka for example, land for the cultivation of maize is not readily available. The few households cultivating maize seek land (for this purpose) from outside the village[74] or in small niches, usually valleys within the village, which may sometimes be far away from homesteads subjecting the crops to the risk of vermin. Most of the valleys within or close to the settled areas are commonly used as *olokeri*, and therefore commonly spared from cultivation by the residents themselves.

In some cases, these farming blocks were located at a considerable distance from the settled niches, making the management of farms difficult. In Oloirobi for example, land zoned for maize is located far away from the centre of the village, not less than 30 minutes' walk (the slopes of Mt. Malanje). As a result, many households do not manage to cultivate the whole portion allocated to them.

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cultivated the area for the purpose of cultivation, and argue that the conditions are not very different from those of cultivated areas in the south-west of Loliondo township.

Transect walks and discussions with heads of households in Oloirobi for example showed that by the end of cultivation in the 1998/99 season only 3 of the 9 households allocated new farms in the cultivation block for Oloirobi residents had cultivated all their land. Some had cultivated only a portion, and others had not even started cultivating. Plate 5.3 shows this patchy pattern in the area. However, the trend is that over time, the whole block will be under cultivation as several households were beginning to settle closer to the farming block.

Plate 5.3: Patchy cultivation in a new cultivation block in Oloirobi

Land use planning in the LGCA also had two levels. The first and most common was planning at village and sub-village level. Here, cultivation niches were identified and distributed among users, but with a consideration of cattle tracks and pasture areas of specific importance e.g. *olokeri*. However, there were

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[74] Four households reported to own land for maize in Sendui and Olbalbal.

observation of some areas formerly used as olokeri that had now been converted to croplands (Plate 5.4), but inquiries revealed that this was done on the consent of the members of the locality (*engutoto*), and in a situation of abundance of such resources in the particular locality.

Plate 5.4: A crucial pasture area turned to cropland in Orkiu, near Ng'arwa.

5.5.1.3 Wildlife constraints

Another ecological constraint is related with wildlife. Areas of particular ecological conditions like the central and northern highlands in the NCA are generally home for resident large herbivores, making cultivation away from the homestead to be a useless endeavour. The problem was reported and observed in Nainokanoka and Oloirobi in the NCA. In Nainokanoka for example, the majority of the cultivated plots were fenced for the purpose of protecting them from wildlife (Plate 5.5), and sometimes, deep furrows were dug to act as a barrier between farmlands/cultivated plots and areas of wildlife. In Oloirobi, incidents of crops destroyed by elephants were common. Residents in Oloirobi and Nainokanoka lamented that the problems of wildlife, which include tedious fencing/protection and uncertainty of harvesting discourage cultivation and expansion of fields, resulting in little land being converted to cultivation.

While managing the problems of wildlife was a tedious activity in the NCA, there were no such observations (furrows or fencing to protect the farms) in the LGCA. Instead, there were reports of scaring away the beast, and cases of animals that had been killed or injured (using fire arms) in exercises of 'scaring away' wild animals from the fields[75]. Moreover, an exercise of ranking problems of cultivation (Appendix 5.4) pointed to the adverse effects of wildlife and livestock among other things. It also paints a picture of the different perceptions between the two zones.

[75] File No. A/AG/TR/Loliondo had a record of 16 wild herbivores that were killed and 8 injured in the period of January – June 1999, on grounds that they had encroached cultivated areas in search of water. A total of 32 ammunition were used.

Plate 5.5: Farm fencing to protect crops from wildlife and livestock

5.5.2 Distance from established cultivators

The general principle on the influence of distance from established cultivators on rangelands conversion is that cultivation spreads gradually over time and space from established cultivators (usually living and cultivating outside the rangelands) into the rangelands. Some established cultivators encroach the rangelands, and in some cases, those in the rangelands adopt cultivation by learning from cultivators. In the case of buffer zones to PAs, cultivators are assumed to encroach the buffer zones firstly in border areas and gradually into the interior of the buffer zones to the border of the core PA. As a matter of logic therefore the intensity of rangelands conversion would decrease gradually from the outer border to the inner border of the buffer zone.

In general, the assumed effect of distance from established cultivators is supported by the proportion of sample households involved in cultivation in the LGCA, and the variation in size of cultivated land in both zones (Tables 5.10a and 5.10b). Table 5.10a presents the percentage distribution of cultivating households in the LGCA, whereas Table 5.10b presents the mean acreage per household, medians and ANOVA statistics in the two zones with respect to distance from established cultivators.

Table 5.10a: % cultivating households by distance from established cultivation

Distance from established cultivation	N	Whether h/h cultivates		Total
		Yes	No	
Away, >20Km	35	62.9%	37.1%	100.0%
Close, <20Km	48	97.9%	2.1%	100.0%
Within cultivators	25	100.0%	0.0%	100.0%
Overall	108	87.0%	13.0%	100.0%

In areas within and close to established cultivators in the LGCA, almost all households (97.8% and 100% respectively) were cultivating. In the contrary, only 62.9 of the households located away from established cultivators were cultivating. The rest (37.1%) were not. Briefly, the observed difference in households' involvement in cultivation supports the influence of established cultivators in rangeland conversion. (In the NCA, this analysis was not done because almost all households in all sites were cultivating - see Table 5.2b).

Analysis based on size of land cultivated in the 1997/98 season between different levels of distance from established cultivators (Table 5.10b) further supports the hypothesis. The patterns are similar for NCA and LGCA, where size of cultivated land decreases with increasing distance from established cultivators. Put simply, it interprets to the generally linear declines in the intensity of cultivation towards the inner borders of the buffer zone, associated with a gradual encroachment and influence of established cultivators.

Table 5.10b Acres cultivated 98 and distance from established cultivators.

Zone	Distance	Distribution				ANOVA statistics		
		N	Mean	Std. Deviation	Median	df	F	Sig.
NCA	Away, >20Km	49	1.29	1.5823	1.00	1	11.188	0.001
	Close, <20Km	49	2.70	1.6313	2.25			
	Total	98	1.99	1.7473	1.50			
LGCA	Away, >20Km	35	0.97	1.0765	0.50	2	10.108	0.000
	Close, <20Km	48	3.12	2.1995	2.50			
	Within cultiv.	25	3.68	2.6036	2.50			
	Total	108	2.55	2.2959	2.00			
Overall	Away, >20Km	84	1.16	1.3957	1.00	2	28.561	0.000
	Close, <20Km	97	2.90	1.9350	2.25			
	Within cultiv.	25	3.68	2.6036	2.50			
	Total	206	2.29	2.0674	1.75			

However, available literature and information obtained through KI interviews and discussions suggest that the generally similar patterns between NCA and LGCA emanate from processes that are rather different, which are associated with the different conservation and development strategies in the two zones. In the LGCA, sites with larger cultivation are those located close to Loliondo town-ship, a niche cultivated by the Kikuyus since 1950's (Map 4). These are Sakala, Wasso and

Ng'arwa. The process was gradual. Cultivation firstly spread into Sakala in the 1960's following population increase (in-migration) in the Loliondo township and its gradual sprawl into the Sakala valley. Thereafter, cultivation spread to Sero sub-village in Ololosokwan[76] during the early 1970's when the two niches (Loliondo and Sakala) were considered to have insufficient land for cultivation. Following directives from the district administrative circles some of the cultivators were allocated land for crop production in Sero[77]. By mid 1980's, cultivation was spreading to Wasso, south of Sakala and Loliondo, and later it spread to Ng'arwa (a Maasai settlement to the north of Loliondo town-ship) in the 1990's[78]. Clearly, the pattern reflects the influence of established cultivators in the spread of cultivation in the zone. It also reflects the influence of associated processes such as in-migration. For example, the three sites – Sakala, Wasso and Sero have a considerable proportion of non-Maasai households as well as in-migrants. The pattern however leaves much to be desired particularly in explaining the earlier spread of cultivation into Ololosokwan (Sero), a considerable distance from the established cultivators when compared to its late spread in Ng'arwa. This is further discussed in chapter 7.

In the NCA where in-migration is controlled, the influence of established cultivators appears to evolve from the ban on cultivation and the eviction of cultivators from inside the NCA. Different sources suggest that the eviction of cultivators from the NCA created pockets of cultivation niches in the NCA (in

[76] Ololosokwan is located in the north-west of Loliondo, and it borders the core PA to the east.
[77] District Agricultural Officer (Loliondo), pers. Comm; Parkipuny (ex-MP) pers. Comm.

Endulen and later in the Nayobi-Kapenjiro area). The lift on cultivation ban simply allowed these cultivator sub-groups to re-emerge as people returning to their land and new-comers disguising themselves as Maasai[79]. See fig. 8.1a (Chapter 7) for patterns of settlement after the lift on cultivation ban.

5.5.3 Influence of economic infrastructure.

The influence of economic infrastructure in the conversion of rangelands was discussed in chapter 2, and chapter 3 provided a picture of the existing economic infrastructure in the study area, particularly that related with transport and markets. The main assumption was that there would be more households taking up cultivation and also larger acreage per household in areas with conducive economic infrastructure as opposed to areas where such services are poor. Table 5.11 presents the distribution of cultivating households with respect to access to roads and markets in the LGCA. (See Appendix 5.3 for the classification of accessibility).

Accordingly, 37% of sample households in areas of difficult access in the LGCA were not cultivating while almost all (100% and 98%) of sample households in areas of moderate and good access were cultivating. Condensing the data into a 2 by 2 table, i.e. by combining the variables 'moderate access' and 'good access' to form one variable 'good/moderate access', a chi-square test suggests that the variation is statistically significant (chi-square 27.188; $p < 0.001$; df = 1). In this

[78] Source: KI discussions; Ole Kukuyet (Chairman of Ng'arwa village); Ole Kashe, (Sakala).

ensuring food security.[80] Moreover, the Loliondo town-ship and the newly developed administrative HQ at Wasso provide a ready market for the crop.

Table 5.11: Cultivating households by access to roads and markets (LGCA)[81]

H/hold		Markets and road access			Total
		Difficult	Moderate	Good	
Cultivates	Count	22	20	52	94
	% within access	62.9%	100.0%	98.1%	87.0%
Do not cultivate	Count	13	0	1	14
	% within access	37.1%	0.0%	1.9%	13.0%
Total	Count	35	20	53	108
	% within access	100.0%	100.0%	100.0%	100.0%
Chi-square test results (2 by 2 table)		Chi-square 27.188; $p < 0.001$; df. 2			

The size of land cultivated in the 1997/98 season was compared between areas of different levels of accessibility to roads and potential markets. Table 5.12a presents the median values (acres) while Table 5.12b presents the results of a two-way ANOVA test.

Table 5.12a shows generally comparable acreage in the overall (between 1.5 and 2.0 acres) and a one-way ANOVA test showed that there was no significant variation in the magnitude of rangeland conversion associated with access to roads and markets. This suggests a lack of pattern and therefore relationship between economic infrastructure and cultivation in the entire study area. However, a two-way ANOVA showed high interaction and therefore a significant variation

[80] Evidence abounds of District administration's efforts to promote cultivation in all areas assumed to have the potentials. File A/FAM/AR/Loliondo present plans for economic empowerment of farmers and trading agents dealing with farm inputs through providing them with credits and loans for agricultural activities, and plans to enhance cultivation of both food and cash crops. File A/AG/TR/Loliondo has folios requesting financial support for irrigated agriculture and ox-ploughing.

[81] In the NCA it was generalised that all households were cultivating. Only four households were not cultivating in respect of the conditions of their residence in the area.

between zones (p = 0.001) and between areas of different levels of access (p = 0.001). In the LGCA sites, the results concur with the overall hypothesis, i.e. there is higher acreage per household in areas/sites of good accessibility and market potentials in the zone compared to areas of poor accessibility (Table 5.12a). In the NCA, variation by this factor is also significant, but in the opposite direction compared to LGCA. Here, areas with difficult access to roads and potential markets had more land under cultivation compared to those with better access to roads and markets (Table 5.12a). It is this contradiction between the zones that resulted to a lack of pattern in the overall results.

Table 5.12a Acres cultivated 1997/98 by access to roads and markets

	Level of Accessibility	N	Mean	SD	Median
Overall	Difficult	58	1.8	1.7	1.75
	Moderate	44	2.2	1.9	2.10
	Good	104	2.6	2.2	2.00
	Total	206	2.3	2.1	1.75
NCA	Difficult	23	3.0	1.7	3.10
	Moderate	24	1.3	1.5	1.00
	Good	51	1.9	1.6	1.75
	Total	98	2.0	1.7	1.75
LGCA	Difficult	35	1.0	1.0	0.75
	Moderate	20	3.3	1.7	2.75
	Good	53	3.3	2.5	2.50
	Total	108	2.5	2.3	2.00

Table 5.12b 2 – WAY ANOVA: Acres cultivated 1997/98 by access to roads and markets

	Sum of Squares	df	Mean Square	F	Sig.
Total	911.702	205			
Between access	165.087	2	82.544	42.725	0.001
Between zones	356.427	1	356.427	184.486	0.001
Error*	390.188	202	1.932		

* Interaction is thrown into error term

5.6 Summary

The overall land cover change (LCC) in the study area is small compared to other buffer areas of the SEU. However, LCC associated with human activities is higher than other types of LCC, and is positively correlated with the magnitude and spatial patterns of cultivation in the study area.

There is more land converted to cultivation in the LGCA compared to the NCA. However, trends suggest that the two zones may, over time, exhibit comparable levels of rangeland conversion given the high proportion of cultivating households in the NCA where cultivation has been allowed only recently. Moreover, considerably large tracts of farmlands are coming under permanent fallow in the LGCA following the closure of wheat project and its associated market and other incentives for the crop.

The spatial distribution of cultivation, while determined primarily by ecological conditions, varies significantly by other factors between the two zones. In the LGCA it is positively influenced by socio-economic factors, particularly accessibility to roads and markets, and also vicinity to established cultivators. Here, the intensity of cultivation decreases with diminishing conditions of accessibility to roads and potential markets, which are not quite related with distance from the core protected area (PA), i.e. the Serengeti National Park. Implied is the development of patches of intensive land-use that do not conform to the purposes of creating the buffer zone.

In the NCA, conservation regulations are more important in influencing spatial distribution of cultivation. Here cultivation was confined to the cultivation blocks zoned by NCA authorities, and the traditional small plots surrounding the homesteads. Higher acreage per household was observed in the less accessible areas, particularly those bordering cultivator communities outside the zone. Implied is a spatial pattern of decreasing intensity (of land-use) from established cultivators towards the core PA, reflecting some form of conformity with the purposes of which the buffer zone was created.

CHAPTER 6

ACTORS IN RANGELAND CONVERSION

6.1 Introduction

One of the main objectives of this study was to examine and document the relative contribution of population sub-groups of different socio-economic and cultural backgrounds in the conversion of the rangelands to cultivation. The main assumption was that households belonging to minority (non-pastoral oriented) sub-groups like shopkeepers and petty traders, wage employees and in-migrants contribute significantly to the conversion of the rangelands. They are alleged to own and cultivate large farms[82]. In the contrary, the majority of resident pastoralists in the study area are thought to be practising small-scale cultivation for subsistence; particularly where/when livestock economy can not meet their subsistence needs[83].

This chapter examines the contribution of these population sub-groups in the increasing cultivation in the study area. Ethnicity, residential status, main sources of income, education and livestock wealth defines the population sub-groups[84]. The chapter is divided into three sections. The first section describes the sample population and its distribution with respect to the said population sub-groups. The

[82] See for example McCabe (1997), Parkipuny (1995).
[83] Mc Cabe (1994) and Potkanski, (1996) estimated an average farm size of 0.5 acres per sub-household (approximately 0.1 acres per RA) to fill subsistence gap in pastoral households in the NCA.
[84] Because the majority of the population in the study area are pastoral Maasai, the sampling was done strategically so as to include, among the resident pastoral Maasai, population sub-groups of

second section analyses the influence of these variables on rangeland conversion, i.e. the relative contribution of the different population sub-groups in increasing cultivation. This is done by comparing cultivation indices between population sub-groups of essentially comparable characteristics across zones and between and within individual study sites. The third section will examine the relative contribution of the different population sub-groups in terms of farming technology and types of crops grown in the study area.

The main hypothesis in this chapter was: Population sub-groups of different socio-economic and cultural backgrounds living in the study area contribute differently to the conversion of the rangelands to croplands. The following sub-hypotheses will be tested alongside the main hypothesis:

1. Size of farms (i.e. household farms and land cultivated in the 1997/98 season) will vary more between population sub-groups of different characteristics than between population sub-groups of comparable/similar characteristics.
2. Size of farms will vary with family size and age structure of family members. (Age structure influences size of household labour).
3. In areas of generally comparable ecological conditions, crops grown will vary between population sub- groups of different socio-economic characteristics.
4. Different farming technologies/practices would be observed with respect to the different socio-economic characteristics of the people.

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different backgrounds like wage earners, retired civil servants, shopkeepers/traders, in-migrants

6.2 Data and methods

This chapter is based on two levels of data sets:

1. General socio-economic data for cultivating households in the sample obtained through questionnaire survey. This provides important socio-cultural background information for all the heads of households, heads of sub-households and other cultivating individuals in the household or sub-household. This includes their ethnicity, residential status, livestock holdings, and sources of income and education. This data is used to desegregate the sample population into population sub-groups of different characteristics, facilitating a comparative analysis of their contribution in the conversion of the rangelands.

2. Qualitative information is also used to clarify and/or supplement the available quantitative information. This was obtained through non-formal interviews and discussions from several households that seemed to have characteristics of peculiar interest e.g. those in leadership and other influential positions, those owning/cultivating significantly large farms, and other rich (in terms of other household assets) and business-oriented households. This information is presented in the form of case studies, as a way of substantiating the significance of these population sub-groups in rangeland conversion.

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and households headed by Non-maasai.

6.3 Determinants of households involvement in cultivation

In chapter 5 it was established that the level of involvement in cultivation in the study area was significantly high (91.3%). Only 8.7% of the sample households were not cultivating[85], and these were distributed differently between the two zones. The LGCA, with no restrictions on in-migration or cultivation, had a larger proportion of households that were not cultivating (13% of sample households in the zone), compared to the NCA where there is control on in-migration, and cultivation is allowed only among resident pastoralists. Here, only 4.1% of the NCA sample households were not cultivating.

Cross-examination of the data showed that the few non-cultivating households in the NCA (4 households) were those falling victim to conservation laws operating in the NCA. Of these, two were households headed by shopkeepers/petty traders, and the other two were households headed by wage employees. One of the employees was a Maasai employed by the NCAA. All the four non-cultivating households were located in sites and strategic locations where they could not circumvent the conservation laws. Three lived in Oloirobi and one in Endulen. Discussions with these heads of households revealed that they could have cultivated but they feared to jeopardise their jobs or conditions that allowed them to pursue their activities in the NCA[86], which they felt were giving them better returns than cultivation would do. It follows therefore that these households'

[85] A household was considered "not cultivating" if none of its members were involved in any form of cultivation, be it individually or by hiring other people to cultivate for them. See chapter 5 section 5.3.1 for the definition of "cultivating household".

[86] Weighing between their non-farm activities (which they were not ready to jeopardize) and cultivation, the activities had better returns than what the respondents could expect from cultivation.

decisions not to cultivate were much influenced by socio-economic characteristics alongside conservation restrictions of the NCAA, particularly residential status and the main household occupation.

In the LGCA, the picture was different. All the 14 non-cultivating households (13% of LGCA sample) were resident pastoralists owning relatively large herds, and all except one resided in Ololosokwan and Arash – areas considered less favourable for cultivated crop but generally better off in terms of livestock productivity. It follows therefore that these households' decisions not to cultivate could be associated with livestock wealth, compounded by ecological conditions.

The above observations however, do not account for all households of the same socio-economic characteristics living in these areas. A comparative examination of cultivating and non-cultivating households by their socio-economic characteristics showed that the cultivating households (188 out of the 206 in the sample) represented population sub-groups of a range of socio-economic variables (Table 6.1). Accordingly, households that were cultivating included also some of those headed by in-migrants, wage earners and shopkeepers-cum-petty traders in the NCA, and some livestock-rich Maasai pastoralists in the LGCA.

The above analysis suggests that it is not easy to come up with straightforward answers on the way different factors influence individual households' decisions. The way different households make decisions on whether or not to cultivate in these rangelands is generally influenced by multiple factors, to include conservation policies, ecological conditions and household socio-economic conditions. These result differently among different individuals, and multivariate analysis could best compare the relative contribution of the different factors. However, the sample size for some of the population sub-groups is too small for this kind of analysis. Therefore, only comparative tests (T-tests and ANOVA) are used in this analysis to try to shed light on the relative importance of the different population sub-groups.

Table 6.1: Cultivating sample households by their socio-economic characteristics

Variable		NCA			LGCA		
		N	Cultivates	Do not cultivate	N	Cultivates	Do not cultivate
Ethnic category	Maasai	72	98.6	1.4	77	81.8	18.2
	Non-Maasai	26	88.5	11.5	31	100.0	0.0
	Total	98	95.9	4.1	108	87.0	13.0
Residential status	Residents	83	97.6	2.4	77	81.8	18.2
	Migrants	15	86.7	13.3	31	100.0	0.0
	Total	98	95.9	4.1	108	87.0	13.0
H/hold occupation	A/pastoralism	76	100.0	0.0	83	83.1	16.9
	Non-pastoral	22	81.8	8.2	25	100.0	0.0
	Total	98	95.9	4.1	108	87.0	13.0
Main source of income	A/pastoralism	62	100.0	0.0	66	78.8	21.2
	Wage employment	14	85.7	14.3	16	100.0	0.0
	Petty trade	6	66.7	33.3	6	100.0	0.0
	Cultivation	14	100.0	0.0	17	100.0	0.0
	Retired Civil Serv.	2	100.0	0.0	3	100.0	0.0
	Total	98	95.9	4.1	108	87.0	13.0
Livestock wealth	No stock	11	90.9	9.1	21	95.2	4.8
	Under 4.0 LE/RA	65	98.5	1.5	39	92.3	7.7
	4.0 – 7.99 LE/RA	15	86.7	13.3	32	90.6	9.4
	8.0+ LE/RA	7	100.0	0.0	16	56.3	43.8
	Total	98	95.9	4.1	108	87.0	13.0
Education level	Non-formal	60	100.0	0.0	66	81.8	18.2
	Primary, complete	27	88.9	11.1	33	93.9	6.1
	Secondary	6	83.3	16.7	3	100.0	0.0
	Professional	5	100.0	0.0	6	100.0	0.0
	Total	98	95.9	4.1	108	87.0	13.0

Moreover, non-cultivating households are excluded in this analysis despite the fact that their socio-economic characteristics are just as important as those of cultivating households. They are excluded because: firstly, they are too few for any meaningful statistics (only 4 in the NCA and 14 in the LGCA). Secondly, their non-involvement in cultivation is more or less associated with location factors. In the NCA they are located in the areas where it is difficult to circumvent the conservation laws (Oloirobi and Endulen - although they wish to cultivate). In the LGCA, they are located in areas that are not very suitable for crop production (Arash and Ololosokwan). Also, the poorer households in these two sites had access to livestock belonging to wealthier households residing in the study sites and elsewhere in the study area. The analysis of the socio-economic characteristics that influence household variations in rangeland conversion is therefore based on 188 cultivating households (from the 206 sample households).

6.4 Influence of household characteristics on rangeland conversion

Outliers and extreme values observed in box-plots (Fig.5.1, chapter 5) and the high SD in mean household acreage (Table 5.3, chapter 5) point to considerable variations in acreage among sample households within and between study sites and zones. The variations are assumed to result from sets of socio-economic and demographic factors at household and sub-household level mentioned above.

ANOVA tests were then run on cultivating households to identify which of the factors were important in explaining variation in rangeland conversion. The main indicators of rangeland conversion used are household farmland and land that was cultivated in the 1997/98 season.

6.4.1 Converted lands and household socio-economic characteristics

Table 6.2 presents ANOVA statistics on rangeland conversion by different socio-economic characteristics for the overall study area. The characteristics include ethnicity, residential status, livestock wealth (measured by LE : RA), main sources of household income, and, levels of education; all as recorded for the head of household.

Table 6.2 ANOVA: Rangeland conversion among cultivating households by socio-economic characteristics (N = 188)

		Household farms		Land cultivated 1997/98	
Variable	df	F	Sig.	F	Sig.
Ethnic category	1	0.136	0.712 (NS)	0.433	0.512 (NS)
Residential status	1	0.953	0.251 (NS)	3.373	0.045 (S)
Rank by LE:RA	3	8.296	0.000 (S)	5.012	0.002 (S)
Income sources	4	15.247	0.000 (S)	13.797	0.000 (S)
Education level	3	6.057	0.006 (S)	1.759	0.349 (NS)

Accordingly, only two of the socio-economic variables are shown to be important in explaining variation in both household farmland and land cultivated in the 1997/98 season between households. These are livestock wealth and sources of income. Residential status appears to be important in explaining variation in land cultivated in the 1997/98 season, but not in household farmland. In the contrary, education seems important in explaining variability in household farmland but not in land cultivated in the 1997/98 season. Ethnic factors do not appear to be important in any of the two variables, at least at this general level.

Table 6.3 Distribution of cultivated land by socio-economic characteristics of cultivating households (N = 188)

Variable		N	Household farmland				Acres cultivated 1997/98			
			Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
Ethnic group	Maasai	134	3.6	3.1	0.3	31.0	2.6	2.2	0.0	11.0
	Non-Maasai	54	3.4	2.4	0.5	12.0	2.4	1.7	0.0	9.0
	Total	188	3.5	2.9	0.3	31.0	2.5	2.1	0.0	11.0
Resid. status	Resident	144	3.7	3.3	0.3	31.0	2.7	2.3	0.0	11.0
	Migrant	44	3.0	2.1	0.5	10.0	1.9	1.0	0.0	4.3
	Total	188	3.5	2.9	0.3	31.0	2.5	2.1	0.0	11.0
Wealth	No stock	30	3.0	2.4	0.5	10.8	1.9	1.1	0.0	4.3
	Under 4.0 LE/RA	100	3.0	2.5	0.5	11.5	2.3	1.8	0.0	9.0
	4.0 - 7.99 LE/RA	42	3.7	3.1	0.5	15.0	2.7	2.0	0.0	11.0
	8.0+ LE/RA	16	7.5	8.1	0.3	31.0	4.1	3.5	0.0	9.0
	Total	188	3.5	2.9	0.3	31.0	2.5	2.1	0.0	11.0
Main source of income	(Agro)pastoralism	114	3.2	2.6	0.3	15.5	2.4	2.0	0.0	9.0
	Wage employment	28	3.5	2.3	0.5	10.8	2.3	1.5	0.5	6.3
	Petty trade	10	1.9	1.6	0.5	5.0	1.2	0.8	0.0	2.5
	Cultivation	31	3.7	2.4	1.0	10.0	2.5	1.5	0.7	7.0
	Retired civil serv.	5	14.2	9.2	4.0	31.0	8.2	2.6	4.0	11.0
	Total	188	3.5	2.9	0.3	31.0	2.5	2.1	0.0	11.0
Educ. level	Non-formal	116	3.3	2.2	0.5	15.5	2.5	1.8	0.0	9.0
	Primary, complete	55	3.4	3.1	0.3	15.0	2.3	2.2	0.0	11.0
	Secondary	8	3.0	2.4	0.5	7.8	1.8	1.3	0.5	4.0
	Professional	9	8.3	8.4	2.0	31.0	3.8	3.0	1.5	8.5
	Total	188	3.5	2.9	0.3	31.0	2.5	2.1	0.0	11.0

Table 6.3 identifies the sources of variations observed in Table 6.2, and post-hoc tests (See Appendix 9, Statistical Annex 2a – 2c) pointed out the livestock rich (>8.0 LE/RA), retired civil servants and professionals as owning and cultivating statistically significant larger farms in their groups.

With regard to livestock wealth[87], rich households owned and cultivated larger farms compared to the poorer ones. Though not all, the few involved in rangeland

[87] The Maasai consider the poverty border-line to be at least 9 cattle per enkaji. Below that, the enkaji is poor. When it has 5 or less, it is very poor and eligible for assistance. In this study,

conversion owned significantly large farms (mean = 7.5 acres, ranging from 0.00 acres to over 30 acres per household while other wealth groups owned between 2.9 and 3.7 acres). The sub-group also cultivated significantly larger farms in the 1997/98 season compared to other wealth groups ($p = 0.002$; $F = 5.021$; $df = 3$).

These means are rather small compared to the level of cultivation that is taking place elsewhere in the east African rangelands, e.g. Maasai-Mara (Kenya) and Simanjiro (Tanzania). However, they may be an indicator of an emerging deviation from the traditional small-scale cultivation, usually considered as part of the traditional pastoral production system in these rangelands.

With regard to sources of income, the pensioners, though very few ($N = 5$), they owned larger farms (mean = 14.2 acres) than the other sub-groups whose means ranged from 1.9 to 3.7. The difference was statistically significant ($p = 0.000$; $F = 13.797$; $df = 4$). The same sub-group cultivated significantly larger farms in the 1997/98 season ($p = 0.000$; mean = 8.2 acres). Means for other sub-groups varied from 1.2 to 2.4 acres. Petty traders were a sub-group with least significance in rangelands conversion. They owned farms averaging 1.8 acres and they cultivated an average of 1.2 acres per household in the 1997/98 season.

Regarding educational levels, significant variation was attributable to a small group of professionals who, though very few ($N = 9$), owned considerably large farms (mean = 8.3 acres compared to other education sub-groups with means

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converted values (LE/RA) are used where: below 4 LE/RA =poor; 4 – <8 LE/RA = medium; ≥8 ranging from 3.0 to 3.5 acres; $p = 0.006$, $F = 6.057$; $df = 3$). However, there was no significant difference in the size of land cultivated in the 1997/98 season between this sub-group and the rest ($p = 0.349$; $F = 1.759$; $df = 3$). This discrepancy between land owned and that cultivated by the professionals is also linked with the changing market conditions associated with the failure in barley cultivation. Explaining the reasons for long fallow, professionals reported to have taken the opportunity of commercial sales associated with the introduction of barley. Since there were no more barley markets, cultivation of these farms was no longer viable.

A comparison between residents and migrants and also between Maasai and non-Maasai showed that there was no significant difference between the groups in terms of size of household farmland, at least at this general level. However, residents cultivated significantly larger farms than in-migrants in the 1997/98 season ($p = 0.045$; $F = 3.373$; $df = 1$). This discrepancy is attributed to the existence of considerably large farms under fallow in the LGCA, many of which are owned by migrants[88]. In other words, some migrants were cultivating only a portion of their farms, and this may be an indication of changing importance of in-migrants in the conversion of rangelands as market forces (that attracted them in mid 1980s) fail.

LE/RA = rich.

[88] Transect walks and KI discussions identified several large farms under fallow whose owners were migrants. Some of the owners were reported to have left the district. The farms were under constant cultivation in the hey-days of barley cultivation, but many are currently under permanent fallow.

6.4.1.1 Influence of socio-economic characteristics compared between zones

The broad level analysis however, obscured a great deal of inter-zone variability. Further analyses (ANOVA) of the same variables but controlling for zone had interesting results (Table 6.4). Some of the factors not shown to be important in Tables 6.2 and 6.3 above were shown to be important, and in some cases, with contradicting patterns (see comments, Table 6.4).

Ethnicity is now shown to be important at zone level (Table 6.4), but with contradicting patterns between the two zones (Tables 6.5a and b). With regard to household farmland (Table 6.5a), non-Maasai own larger farms than Maasai in the NCA (means were 3.5 and 2.1 acres respectively; $p = 0.036$). However, no significant difference is observed with respect to the size of household farms between the two groups in LGCA ($p = 0.066$).

Ethnic differences showed an interesting pattern in current cultivation. In the 1997/98 season (Table 6.5b), non-Maasai households cultivated larger farms than Maasai households in the NCA did (2.8 acres/household and 1.8 acres/household respectively, $p = 0.031$). In the LGCA it was Maasai households which cultivated larger farms than those of non-Maasai (3.4 acres/household and 2.1 acres/household respectively; $p = 0.008$)[89]. It is this contradiction that levelled the overall results in land cultivated in 1997/98 (Table 6.2).

[89] It was realised during interviews that a number of wealthy Maasai households had moved to the cultivation niches of LGCA (Wasso, Sakala and Ng'arwa) where they were owning and cultivating

Table 6.4 ANNOVA statistics: Cultivation compared between zones by household characteristics

Household variable	Conversion variable	Overall p-value	NCA p-value	LGCA p-value	Comments
Ethnic category	H/hold Farmland	0.729	0.036	0.066	Not significant in the overall and LGCA. Significant in NCA; Non- Maasai own larger farms.
	1997/98 cultivation	0.549	0.031	0.008	Non-significant in the overall, but significant in each of the zones; with a conflicting pattern: Maasai cultivated larger farms than non-Maasai in LGCA; Non-Maasai cultivated larger farms than Maasai in the NCA.
Residential status	H/hold Farmland	0.235	0.573	0.054	Non-significant in the overall and individual zones.
	1997/98 cultivation	0.042	0.552	0.006	Significant in the overall and LGCA (probably an effect of resident cultivators in LGCA who cultivated larger farms than in-migrants). No difference in NCA
Wealth rank by LE:RA	H/hold Farmland	0.000	0.000	0.017	Significant; similar pattern in both zones (wealthier households own larger farms).
	1997/98 cultivation	0.002	0.019	0.078	Variation in overall and NCA patterns. Wealthier households cultivated larger farms than poorer ones. No difference in LGCA though it emerges (with wealthier households cultivating more) when Ololosokwan and Arash are excluded.
Sources of income	H/hold Farmland	0.000	0.000	0.000	Significant variation, similar pattern in both zones. A small group of retired civil servants own significantly larger farms. Petty traders own significantly small farms.
	1997/98 cultivation	0.000	0.000	0.001	Similar pattern for NCA and LGCA. A small group of retired government employees influence the pattern. (Non-significant variation if the group is excluded from the analysis). Very little cultivation by petty traders.
Level of education	H/hold Farmland	0.006	0.741	0.008	Significant in the overall and LGCA, due to the influence of a small group of professionals who own larger farms. Non-significant if the group is excluded in the analysis. Not significant in NCA.
	1997/98 cultivation	0.349	0.576	0.561	No pattern.

relatively larger farms (compared to the non-Maasai resident cultivators) while keeping their large

Differences in residential status of household heads Tables 6.4 and 6.5a & b also revealed a contradicting contribution of in-migrants in rangeland conversion in the two zones. There was no significant variation between in-migrants' and residents' households in the overall and between the zones in terms of the size of household farms ($p = 0.235$ for overall, 0.573 for NCA and 0.054 for LGCA). Similarly, there was no significant difference between in-migrants and residents in terms of land cultivated in the 1997/98 season in the NCA ($p = 0.552$). However, residents were shown to cultivate larger farms in the 1997/98 season in the overall ($p = 0.042$) and in the LGCA ($p = 0.006$) compared to migrants.

Table 6.5a: Distribution of household farms by socio-economic characteristics of cultivating households (N = 188).

Variable	Category	NCA			LGCA		
		N	Mean	SD	N[90]	Mean	SD
Ethnicity	Maasai	71	2.1	1.98	63	5.2	4.97
	Non-Maasai	23	3.5	2.89	31	3.4	2.33
	Total	94	2.5	2.26	94	4.6	4.35
Resid. status	Resident	81	2.5	2.39	63	5.2	4.96
	Migrant	13	2.3	1.18	31	3.4	2.34
	Total	94	2.5	2.26	94	4.6	4.35
L/stock wealth	No stock	10	1.9	1.44	20	3.5	2.74
	Under 4.0 LE/RA	64	2.3	1.73	36	4.2	3.10
	4.0 - 7.99 LE/RA	13	1.9	1.15	29	4.6	3.32
	8.0+ LE/RA	7	5.8	5.01	9	8.8	9.90
	Total	94	2.5	2.26	94	4.6	4.35
Sources of income	(Agro)pastoralism	62	2.4	2.16	52	4.2	3.47
	Wage employment	12	2.1	1.08	16	4.5	3.36
	Petty trade	4	0.9	0.25	6	2.6	1.74
	Cultivation	14	2.5	1.44	17	4.6	2.76
	Retired civil serv.	2	10.5	2.12	3	16.7	13.57
	Total	94	2.5	2.26	94	4.6	4.35
Education level	Non-formal	60	2.5	2.04	54	4.1	3.14
	Primary, complete	24	2.2	2.14	31	4.5	3.75
	Secondary	5	2.1	1.43	3	4.6	3.13
	Professional	5	5.1	3.40	6	10.4	10.76
	Total	94	2.5	2.26	94	4.6	4.35

herds of livestock in the more favourable sites like Arash and Ololosokwan.

Table 6.5b: Distribution of land cultivated in the 1997/98 season by socio-economic characteristics of cultivating households (N = 188).

Variable	Category	NCA			LGCA		
		N	Mean	SD	N	Mean	SD
Ethnicity	Maasai	71	1.8	1.61	63	3.4	2.50
	Non-Maasai	23	2.8	2.39	31	2.1	1.09
	Total	94	2.1	1.84	94	2.9	2.22
Resid. status	Resident	81	2.1	1.93	63	3.4	2.51
	Migrant	13	1.9	1.15	31	2.0	1.63
	Total	94	2.1	1.84	94	2.9	2.22
L/stock wealth	No stock	10	1.6	1.19	20	2.0	1.09
	Under 4.0 LE/RA	64	2.0	1.62	36	3.0	2.08
	4.0 - 7.99 LE/RA	13	1.8	1.07	29	3.2	2.23
	8.0+ LE/RA	7	4.0	3.45	9	4.2	3.81
	Total	94	2.1	1.84	94	2.9	2.22
Sources of income	(Agro)pastoralism	62	2.0	1.74	52	2.9	2.24
	Wage employment	12	1.7	1.60	16	2.8	1.65
	Petty trade	4	0.9	0.24	6	1.3	0.98
	Cultivation	14	2.3	1.25	17	2.8	1.66
	Retired civil serv.	2	8.6	0.53	3	7.8	3.55
	Total	94	2.1	1.84	94	2.90	2.22
Education level	Non-formal	60	2.2	1.57	54	2.9	2.05
	Primary, complete	24	1.7	1.68	31	2.9	2.48
	Secondary	5	1.6	1.47	3	2.1	1.42
	Professional	5	2.5	3.48	6	4.1	2.76
	Total	94	2.1	1.84	94	2.9	2.22

Smaller acreage in the 1997/98 cultivation for migrants in the LGCA in a context of generally comparable size of household farms was interpreted as an indication of a changing importance in the contribution of migrants in rangelands conversion in the zone, associated with the changing market influences. They (in-migrants) said they were currently cultivating for subsistence, and they did not cultivate the large farms formerly under barley because of market problems. With regard to household farmland, livestock wealth had significant influence. In all levels, some livestock-rich households owned larger farms than the other wealth groups. For the 1997/98 season, significant differences associated with livestock wealth

[90] The values of N for ethnicity and residential status in the LGCA are similar. However, cross-examination of the data showed that this was mere coincidence as the values come from different

are seen in the overall ($p < 0.001$) and the NCA ($p < 0.001$) only, where wealthier households cultivate larger farms than the poorer ones. There is no significant difference (for the 1997/98 season) between wealthy and poor households in LGCA ($p = 0.078$). The lack of significant difference in LGCA is linked with the apparent division of the zone into two land-use regions: A region dominated by cultivation and/or agro-pastoralism (Sakala, Wasso and Ng'arwa) on one hand, and, on the other hand, and a region dominated by livestock (Ololosokwan and Arash), where cultivation is minimal.

Sources of income portrayed significant inter-group variation in rangeland conversion in all levels – overall and individual zone level in both household farmland and land cultivated in the 1997/98 season. On one end, a minority sub-group of retired civil servants ($N = 5$) owned and cultivated larger farms in the overall and in each zone. On the other end, another minority sub-group of petty traders and shopkeepers ($N = 10$) owned and cultivated comparably small farms. This has an implication that these two income sub-groups have significantly differing effects on rangeland conversion irrespective of the land use policy.

Levels of education were important only in household farms. Variation in household farms was significant in the overall data ($p = 0.006$) and in the LGCA ($p = 0.008$) where a small group of professionals owned significantly larger farms compared to the other education sub-groups. That this education sub-group had no significant influence in the NCA results from the fear of professionals that they may jeopardise their employment.

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cases.

6.4.1.2 Socio-economic characteristics and spatial variations in cultivation

The difference in results between Table 6.2 and Table 6.3 and the patterns emerging when we control for zone suggest that some population sub-groups may become more important (or otherwise) within the same zone when analysed with respect to the spatial factors reflected in individual site analyses. In other words, population sub-groups of comparable characteristics may have more influence on specified locations and less on others, depending on both spatial and policy-related factors. This section teases this out, as a way of examining the spatial influence of the different household characteristics in cultivation up-take. The variables considered are ethnicity, residential status and livestock holdings[91]. However, the samples for some of the population sub-groups become too small for statistically meaningful statements when brought down to lower level (locations) analyses (e.g. analyses by individual sites). For this reason, we will combine quantitative with descriptive-cum-qualitative analyses depending on sample size and available data.

6.4.1.3 Spatial influences of ethnic diversity

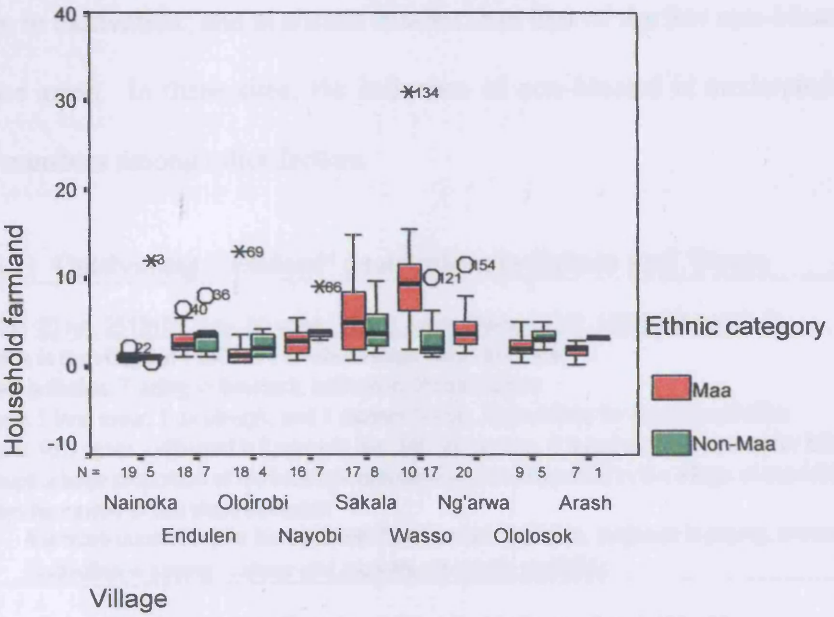
Individual study site analyses suggested existence of spatially varied impacts of ethnicity on the rangelands, both in the NCA and in the LGCA. In the NCA (Fig. 6.1), non-Maasai have more impacts in Nayobi and Endulen villages when compared to the impacts of Maasai in the same villages[92]. In Nainokanoka and

[91] Sub-groups influencing variation with regard to sources of income and levels of education were too small, and most of them were located in Sakala and Wasso.

[92] Nayobi is a border case adjacent to agro-pastoral Waarusha in the east, and Endulen is easily accessible by agro-pastoral Wambulu from the south. Moreover, several sources paint the two sites as having been under the influence of cultivators even before the 1975 cultivation ban (WTCM, 1993; Mc Cabe, 1997; MTNRE, 1994).

Oloirobi, the comparative impact between Maasai and non-Maasai is non-significant, mainly because of lack of cultivable land[93]. More over, Oloirobi is located close to the NCA HQ where it is not easy for the non-Maasai to circumvent the laws.

Fig. 6.1a: Ethnicity and cultivation



In the LGCA (Fig. 6.1), Maasai cultivates larger farms than non-Maasai in Sakala, Wasso and Ng'arwa - the three sites defined as accessible and ecologically suitable for cultivation. An examination of qualitative data pointed to some educated and/or rich, well-to-do business-oriented Maasai from different parts of the zone[94] as contributing significantly to the high acreage among Maasai in

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[93] Because of ecological conditions, cultivation in these sites is more or less confined to small plots (vegetables and potatoes).

[94] Educated and/or richer, business-oriented Maasai move to Wasso, Loliondo and Sakala (from the remote areas) because of availability of social services.

Sakala and Wasso (see case studies in box 6.1). Otherwise, exclusion of these extreme cases would place non-Maasai at a slightly higher acreage compared to that of Maasai. Implied is that the influence of non-Maasai in these two sites remains to be important, basically because of their numbers.

Ng'arwa is a slightly different case where pastoral Maasai have come together and engaged in cultivation with the support of the district administration. In the remaining remotely located sites (Ololosokwan and Arash), very few Maasai engage in cultivation; and at a scale smaller than that of the few non-Maasai found in those areas. In these sites, the influence of non-Maasai is moderated by their small numbers among other factors.

Box 6.1: Cultivating 'resident' pastoralists in Sakala and Wasso

Case 108: ID No. 2513101; Age: 50 years; Ethnic group: Maasai; TLE: 139.4; Education: 2

- Came in the village in 1990 from another village within the zone
- Main activities: Trading in livestock, cultivation, transportation
- Owns 1 land rover, 1 ox-plough, and 1 modem house. Hires labour for farming activities
- Owns 15.5 acres, cultivated 9.0 acres in the 1997/98 season, 6.5 acres have been under fallow since 1993.
- Keeps a large proportion of his livestock with another sub-household in the village of domicile.
- Says he moved to this place because:
  - ➢ It is more convenient for his business: Services are available, business is paying, movement is easier.
  - ➢ Cultivation is paying. Labour and markets are readily available

Case 90: ID No. 1412101; Age: 65; Ethnicity = 2 Education 4; Occupation: 4; LU = 31

- Migrated from zone 1 in 1990. Chose this village to cultivate alongside livestock keeping. Says, 'an *olmarei* should have enough food to be called an *olmarei*'.
- Says in place of domicile he could not cultivate as extensively as he wanted; availability of labour and land were major limitations.
- Owns and cultivates 7.5 acres. Has requested for another 4 acres which he hopes to get and start cultivating by next season. Hires labour for farming activities.

Case 137: ID No. 2617101; Age: 62, Ethnic group: Maasai; TLE: 146; Education: 2

- Retired from a district-level leadership position.
- Owns 1 modem house, 1 grain milling machine, 1 business house, 1 land rover
- Thinks that the present location is more ideal for his business and cultivation.
- Owns 31 acres; 16 of which are located in one of the best cultivable niches in the village, yielding approximately 12 bags (90Kg) per acre. Cultivates 16 acres annually; has 15 acres under forest fallow, which he declares to be an ***olokeri*** for his household; not allowed for use by other households.
- Thinks that the current trend in the area is one towards private ownership of land; and those who are not aware of this will suffer in the future. All good land will be in the hands of new-comers.

6.4.1.4 In-migrants' spatial influences in rangeland conversion

In the NCA, there was no significant difference in the size of converted land between residents and migrants. However, when the residential factor is examined spatially across study sites, a pattern closely similar to that observed in the case of ethnic groups emerges. In Nainokanoka and Oloirobi, the bars representing the size of land cultivated in the 1997/98 season were generally comparable between migrants and residents. However, migrants had a generally higher acreage compared to residents in Nayobi and Endulen[95].

Residents were shown to cultivate larger farms than migrants in the LGCA. The significance of residents in rangeland conversion in this zone is observed in three sites: Sakala, Wasso and Ng'arwa. This results from significantly high acreage among the few, well-to-do Maasai (section 6.4.3.1, here defined as residents) in Sakala and Wasso (see box 6.1), and the significant contribution of Maasai pastoralists in Ng'arwa. Sample households in Ng'arwa belonged to residents (except one), and they all cultivated farms that are generally larger than the traditional small-scale cultivation renown among Maasai pastoralists[96].

In Ololosokwan, migrants cultivated larger farms than residents. However, they owned and cultivated smaller farms than migrants in Wasso and Sakala. The level of cultivation observed in Arash was generally too small for any meaningful

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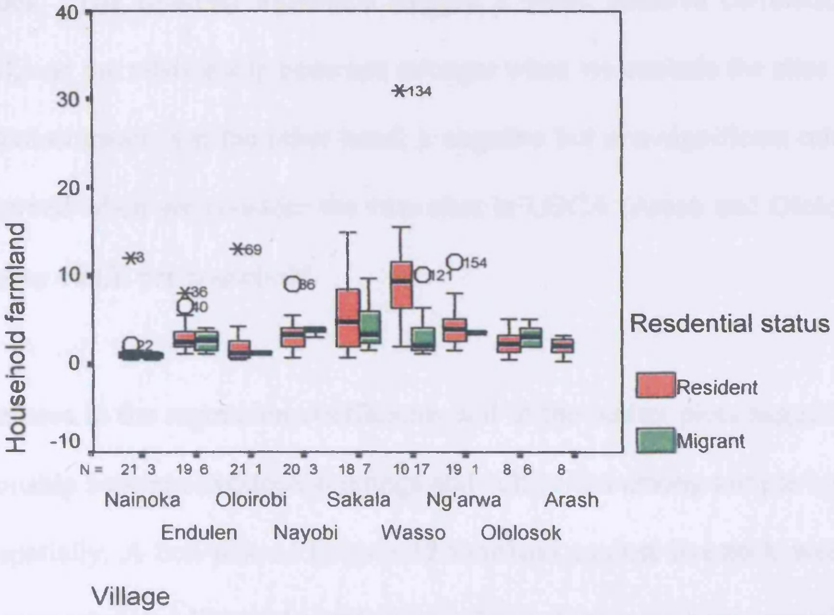
[95] Literature shows the importance of non-Maasai in rangeland conversion in the two sites (and other areas of NCA) prior to the 1975 cultivation ban. (See for example Grant, 1954; Gulliver, 1955; Fosbrooke, 1988; TWCM, 1993, and McCabe, 1989)

[96] The Maasai of Ng'arwa may be in their early stages of a changing orientation towards agropastoralism because: All households were cultivating; they own and cultivate large farms

comparison between residents and migrants. Except for a few plots that formed a small cultivation stretch along Ngaliyapus valley, cultivated areas were more or less the traditional small fields close to/surrounding the homestead.

Despite the significant contribution of the few well-to-do residents in rangeland conversion in the LGCA, the impact of migrant cultivators remains to be important in three sites – Sakala, Wasso and Ololosokwan. These are areas with a long history of cultivation or those influenced by resettlement policy (e.g. Sero in Ololosokwan).

Fig. 6.1b. Residence and cultivation



(mean = 4.2 and 3.3 acres respectively); use oxen ploughs; construct houses with grain storage facilities.

6.4.1.5 Livestock wealth and spatial variations in rangeland conversion

Livestock wealth was shown to be important in explaining variability in household farms (section 6.3.1 and 6.3.2), with wealthier households owning and cultivating larger farms. Regression analyses point to a weak linear positive correlation between livestock holdings and household farmland except when the analysis was confined to Arash and Ololosokwan only (Table 6.6).

Table 6.6 Regression Coefficients: Size of herds and size of farms

Area	Adjusted R^2	Std. Error	R^2 change	F Change	df	Sig.
All sites	0.124	3.5430	0.129	23.188	156	0.000
Sites 1 - 7[97]	0.153	3.6976	0.159	25.426	134	0.000
Arash & Ololosokwan	-0.014	1.2666	0.035	0.719	20	0.407

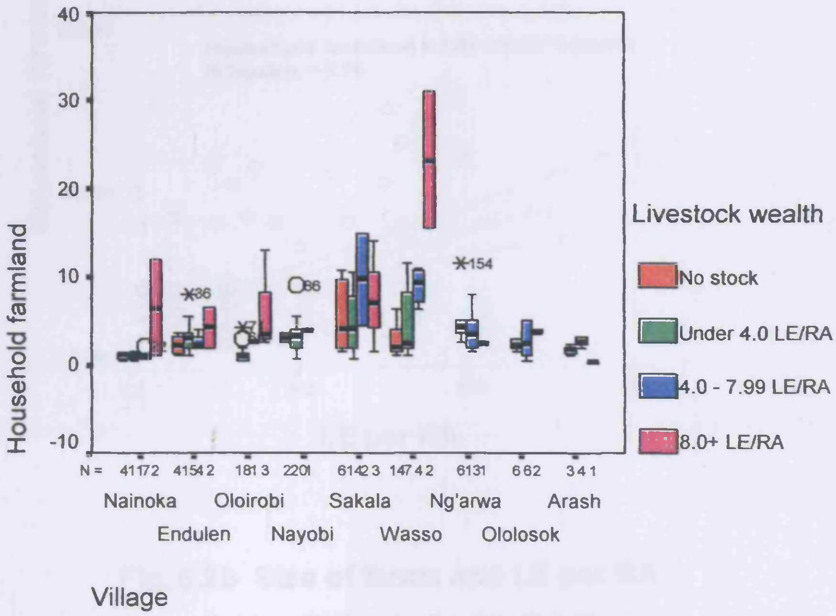
Scatter plots (Figure 6.2a & b) however, do not show clear linearity between LE:RA and household farms, even when considering only those households with livestock. The resulting equations suggest a weak, positive correlation in the overall, and the relationship becomes stronger when we exclude the sites of Arash and Ololosokwan. On the other hand, a negative but non-significant relationship is observed when we consider the two sites in LGCA (Arash and Ololosokwan) with over 40 LE per household.

Differences in the regression coefficients and in the scatter plots suggest that the relationship between livestock-holdings and cultivation among sample households vary spatially. A box-plot of household farmland against livestock wealth (Fig. 6.1c) suggested that livestock-cultivation relationships were better explained by a

[97] Sites 1 – 7 are: 1. Nainokanoka, 2. Endulen, 3. Oloirobi, 4. Nayobi, 5. Sakala, 6. Wasso, 7. Ng'arwa.

combination of spatial factors and individual household characteristics, whose spatial distribution also vary between study sites.

Fig. 6.1c. Livestock and cultivation



The overall plot has an expansive vertical scale for both the inter-quartile boxes and the whiskers, and a considerable number of cases standing out as outliers and extreme values. In Ololosokwan and Arash, there were no extreme and outliers cases despite the presence of several livestock-rich households, with over 8.0 LE:RA. A cross-examination of the data showed that the observed extreme and outliers cases had, in addition to high LE:RA, one or several of the following characteristics: Other assets defining them as wealthy, higher levels of education, political and/or traditional leadership positions, retired officers (mainly from leadership positions), other income generating business. In the contrary, data for Ololosokwan and Arash did not show these attributes for the livestock-rich cases.

Fig. 6.2a Size of farms and LE per RA

(Households with livestock; sites 1 - 7)

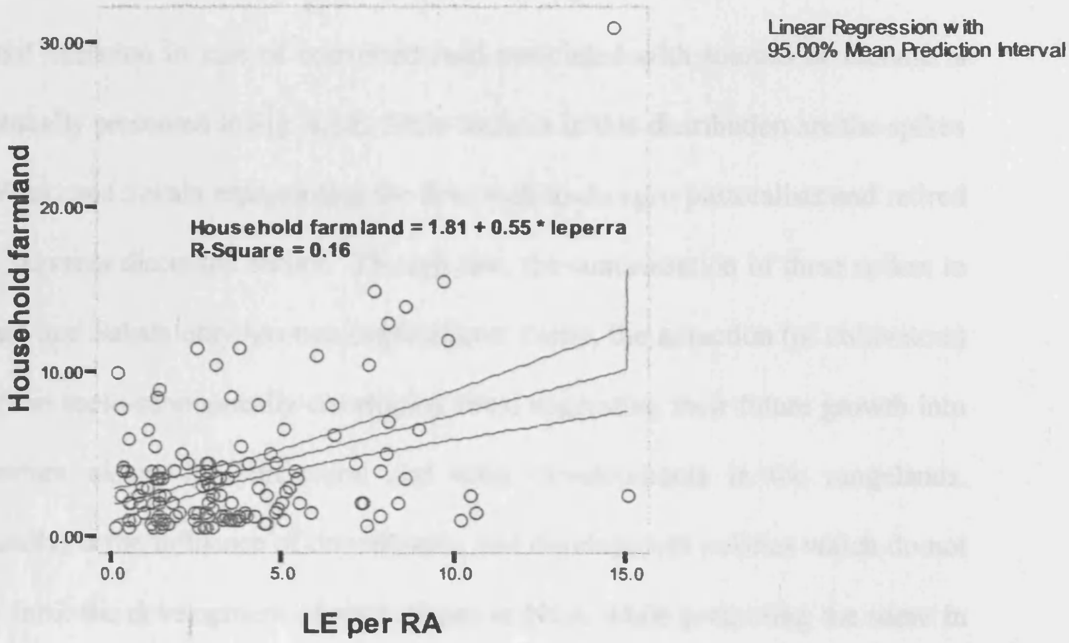
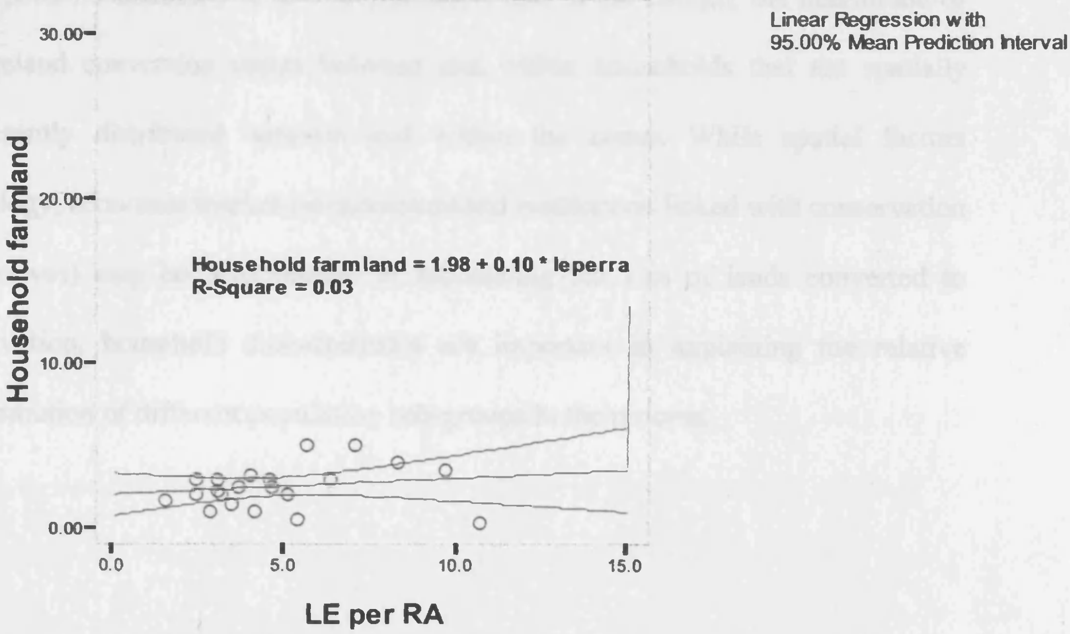


Fig. 6.2b Size of farms and LE per RA

(Households with livestock; sites 8 & 9)



6.4.1.6 Sources of income and cultivation

Spatial variation in size of converted land associated with sources of income is graphically presented in Fig. 6.1d. Main features in this distribution are the spikes in Wasso and Sakala representing the few, well-to-do agro-pastoralists and retired civil servants discussed earlier. Though few, the concentration of these spikes in Wasso and Sakala only has two implications: firstly, the attraction (of cultivators) by these socio-economically developing sites, suggesting their future growth into important niches for cultivation and other developments in the rangelands. Secondly, is the influence of conservation and development policies which do not only limit the development of such niches in NCA while promoting the same in LGCA but also creates important variations in spatial distribution of the human population in the area.

The patterns discussed in this section show that in the overall, the magnitude of rangeland conversion varies between and within households that are spatially differently distributed between and within the zones. While spatial factors (ecology, economic/market infrastructure and restrictions linked with conservation objectives) may be instrumental in influencing the size of lands converted to cultivation, household characteristics are important in explaining the relative contribution of different population sub-groups in the process.

6.4.2 Household demography and size of converted lands

It was hypothesised that variations in household demography will influence rangeland conversion in terms of labour availability, crop types and farming technology. This section focuses on the influences of such household characteristics.

6.4.2.1 Influence of ethnic composition of households

In addition to the 206 heads of households (all males), the sample households constituted a total of 317 women who were heads of sub-households. Of these, 253 were involved in cultivation, and only 64 were not. A cross-examination of the data showed a large proportion of the non-cultivating sub-households belonged to the pastoral Maasai ethnic group, and they all owned reasonably large herds. Moreover, they were wives of livestock-rich husbands, mostly in those households which were not involved in cultivation. There were also a few wives (sub-households) who were not cultivating although the households in which they formed part were cultivating.

Such observations were common among households where cultivation rested upon individual sub-households, and the head of household had not decided to involve in cultivation. Only a few of the non-cultivating sub-households (11 out of the 64) were found in the NCA. The remaining (53) resided in the LGCA, majority of them in the sites of Ololosokwan and Arash. The sub-households involved in cultivation were of different ethnic backgrounds, distributed randomly among Maasai and non-Maasai households.

The influence of ethnicity in the magnitude of rangeland conversion was significant in all levels (overall and individual zones) when analysis was brought down to sub-household level. Non-Maasai sub-households owned and cultivated significantly larger farms compared to Maasai sub-households (Table 6.7). The pattern was consistent in the overall and in individual zones for both size of sub-household farmland and that of land cultivated in the 1997/98 season.

Table 6.7: Variation in cultivation among sub-households by ethnicity (N = 253)

Variable	Zone	Ethnic group	N	Acres	df	t-statistic	p-value
Household farmland	Overall	Maasai	178	0.65	251	-4.133	0.000
		Non-Maasai	75	1.13			
	NCA	Maasai	82	0.71	123	-2.683	0.008
		Non-Maasai	43	1.04			
	LGCA	Maasai	96	0.59	126	-3.206	0.002
		Non-Maasai	32	1.25			
Land cultivated 1997/98 season	Overall	Maasai	178	0.53	251	-4.197	0.000
		Non-Maasai	75	0.92			
	NCA	Maasai	82	0.63	123	-2.687	0.008
		Non-Maasai	43	0.94			
	LGCA	Maasai	96	0.45	126	-3.038	0.003
		Non-Maasai	32	0.91			

6.4.2.2 Family size and household structure:

In most agricultural studies, family size is shown as positively correlated with the size of farms. This is because family size and age structure provides a gross estimate of the size of output required from the farm. Moreover, the age-structure of members of a household influences the size of farms in terms of labour availability.

In this study the influence of family size and age distribution of members of a family was analysed with respect to size of farms cultivated in the 1997/98 season (Table 6.8). Accordingly, significant correlations were observed between family size and size of land cultivated in the season in question in all levels (overall, among Maasai households and among non-Maasai households). This fits in the social-economic setting of the majority of the populations in the study area. The polygynous culture, and that every head of a sub-household is responsible for the sub-household's subsistence requirements interprets into an increase in the size of cultivated land alongside the increasing number of wives and people in the household.

Table 6.8: Correlation: Demographic variables and size of cultivated lands

	Overall			**Maasai**			**Non-Maasai**		
	Standardized Coefficients (Beta)	t	Sig.	Standardized Coefficients (Beta)	t	Sig.	Standardized Coefficients (Beta)	t	Sig.
Family size (total)	.216	3.017	.003	.285	3.421	.001	.678	6.657	.000
Children, <10yrs.	.058	.917	.360	.043	.677	.499	.110	1.275	.205
Children, 10 – 14 yrs.	.347	5.045	.000	.568	4.981	.000	.089	1.408	.160
Female adults, 15 – 34 yrs.	.374	5.499	.000	.391	4.882	.000	.277	2.077	.043
Male adults, 15 – 34 yrs.	.097	1.117	.266	.016	.252	.801	.301	2.273	.027
Adults, > 35 yrs.	.325	4.690	.000	.217	2.552	.012	.628	5.820	.000

Analysis based on household age structure resulted into a pattern of correlation that reflects varying importance of some age-groups in influencing size of farms. In the overall, a significant positive correlation was observed between size of farms cultivated in the 1997/98 season and the number of people in the following age-groups: children aged 10 – 14 years, female adults aged 15 – 34 years and adults aged 35 years or more. No significant correlation was observed with respect to children under 10 years and male adults aged 15 – 34 years. This pattern suggests the cultural division of labour in the study area. Generally, children aged between 10 and 14 do provide a substantial amount of household labour that can be allocated for crop production activities. On the other hand, males aged between age 15 and 34 fall in the category of murran, whose major obligation rests with livestock grazing.

A similar analysis but controlling for ethnicity affirmed the influence of cultural division of labour typical among Tanzanian Maasai communities. Correlation between size of farms cultivated in the 1997/98 season and number of children aged 10 – 15 years was significant among Maasai households. It was non-significant among non-Maasai households. On the contrary, significant correlation was found between size of farms cultivated in the 1997/98 season and male adults aged between 15 and 34 years (*murran* equivalent) among non-Maasai households. Non-significant correlation was found with respect to children aged 10 – 15 years, probably because the majority would be in school.

These variations are more or less a reflection of availability of household labour, which varies by age. In most cultivator communities, all the people in a household generally participate in farming activities. However, cultivation activities are still perceived to be the work of women and children among Maasai communities, in which case *murran* are not included. Implied in these observations therefore is the role of household labour in influencing the size of land cultivated. Yet, labour availability is not simply defined by number and age of household members. Its definition varies with cultural background of the people.

6.5 Household characteristics and farming technology

Despite the size of converted land, household characteristics were assumed to influence cultivation in the context of types of crops and farming technology. Population sub-groups of different backgrounds, particularly different ethnic and cultural experiences were thought to bring farming innovations and new methods in the study area.

6.5.1 New crops and species

Available literature documents a range of tropical crops observed in the area in the past, some documented as observed at least as far back as 1950's[98]. During transect walks, most of these crops were observed in most of the areas, intensity depending on ecological conditions. Alongside these 'native' crops, crops that had not been documented anywhere before 1980's were observed in different parts in the study are. These were none other than vegetables of different types. Discussions with KI revealed that most of these crops were introduced in the study area by in-migrants and/or non-Maasai by mid 1980's (see for example Box 6.2).

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[98] See for example, Fosbrooke (1988), Grants (1953), NLUPC, (1987). They document crops like maize, beans, pigeon peas, sweet and round potatoes, sorghum, finger millet and few stands/patches of bananas and tobacco.

Table 6.9: Ethnicity and types of crops cultivated in Nainokanoka/Oloirobi[99]

	Maasai (N* = 81)	Non-Maasai (N* = 22)	Overall (N* = 103)
Maize/pulses	34.6%	31.8%	34.0%
Potatoes (round)	70.4%	45.5%	65.0%
Tobacco	23.5%	22.7%	23.3%
Vegetable	37.0%	100.0%	50.5%

*N refers to heads of sub-households.

Where climate and market factors allow, the influence of ethnic differences was also observed in crops grown (Table 6.9). In the two sites where ecological conditions favour a variety of crops (though with little maize), all (100%) of the non-Maasai sub-households cultivated vegetables while only 37% of the Maasai sub-households did. In the contrary, 70.4% of Maasai sub-households cultivated potatoes in the same area compared to 45.5% of the non-Maasai sub-households. Yet, the potato was considered a major crop in these sites where land for maize/pulses was insufficient. Much of it was sold (to lodges and Karatu township dominated by non-Maasai) to purchase grain.

The ethnic influence in the cultivation of vegetables was stronger in the LGCA. Only two out of 14 Maasai households (i.e. 4 sub-households out of 30 sub-households) cultivating vegetables in the overall sample were found in LGCA. Otherwise it was non-Maasai households that cultivated vegetable gardens/patches in the area. Patches of tobacco were however distributed almost randomly among the few households cultivating the crop.

[99] This kind of comparisons was not possible for other sites because of the dominance of maize and pulses and very little/absence of other crops.

Box 6.2: Introduction of new crops in the study area

ID. No. 1109101; Age, 37 years, Ethnic group: Non-Maasai, Education level: 3

- Obtained secondary education in a Seminary in Kenya in the 1970,s. In the seminary, he learned some horticulture.
- Joined relatives in the village in 1986.
- Started a small vegetable garden in 1987, initially for own consumption. (Obtained seeds from Arusha town).
- Increased size of garden after construction and opening of Sopa Lodge (a tourist hotel generally accessible from this village)
- Was a supplier (tendered) of vegetable to the hotel since 1994
- Encouraged others to cultivate vegetables (which he bought as a middle-man) to ensure that he could maintain a continuous supply for the hotel.
- Says he was the first person in the village to engage in the production of vegetable for the market.
- Had the richest variety of vegetable species to include: cabbage, carrots, lettuce, cauliflower, spinach, broccoli and leeks to mention a few.

6.5.2 Farm/crop management

The process of crop production in general involves several chronological stages: field preparation, tilling/ploughing, planting/sowing seeds, weeding, thinning (depending on the type of crop) harvesting and storage.

In general, these stages were adhered to in almost all population sub-groups in all study sites. A few differences were however observed in the stage of weeding (for maize/pulses). In most fields in the LGCA (except those in Sakala, Wasso and Ng'arwa), this stage was substituted by pulling out the weeds instead of actual weeding using a hoe. The peoples' responses (as to why they did not do the kind of weeding that involves the use of the hoe) suggested that this was what they perceived as weeding. Probably this perception is associated with the fact that most of the cultivated lands in these areas do not have many weeds due to the arid nature of the area. In exception of this weeding conception, practices and techniques of farm and crop management did not vary much among the majority of the actors. Only a few cases were observed to practice agricultural tasks reflecting cultivation skills commonly observed among experienced cultivators. In two cases we observed contour type of cultivation in slope areas, practised by non-Maasai individuals in LGCA. The use of pesticides in vegetable gardens was observed among two individuals in Nainokanoka, and one individual using animal manure (in vegetable nursery beds) in Oloirobi. Otherwise, farm and crop management practices were generally comparable among the different population sub-groups.

Another important observation was that of storage facilities/methods for maize/pulses. Traditionally, grain was usually stored inside houses, randomly wherever space was available or in a small storage area constructed within the house. Sometimes, maize (on cobs) could be hung high above the fire-place – a common method of string seeds for the next season. This method was common among most of the households.

Alongside the traditional indoor method, some households had started to adopt the modern, outdoor method commonly used and encouraged by agricultural extension officers throughout the country. These are small huts with tin pan roofs, or basket-type of containers (also with tin pan roofs) placed on stilts. Plate 6.1 is an example of the modern storage huts.

Plate 6.1: Grain storage hut in N'garwa, LGCA.

These modern stores were common in Sakala and Wasso. In Ng'arwa, both in-house and outdoor storage facilities were being constructed. The indoor space was constructed in such a way that it had enough space and it was not accessible to the calves/shoats, which normally sleep in the house. Inclusion of this type of storage in the house goes hand in hand with changing housing style (see plate 6.2).

Plate 6.2: Changing housing style to include upper space for grain storage

6.6 Conclusion

The chapter has explored the relative contribution of the different population sub-groups in the study area. The main hypothesis is supported, as these population sub-groups have been shown to contribute differently to the conversion of the rangelands.

The most important sub-group in converting rangelands to croplands in the study area is that of rich, business oriented resident Maasai, including some professionals and retired civil servants. This sub-group owns and cultivates substantially large farms in both NCA and LGCA. The contribution of other population sub-groups in the conversion of the rangelands varies considerably by zone. In-migrants and non-Maasai sub-groups are important in LGCA sites with a long history of cultivation and development policies that encourage both cultivation and attendant in-migration. Cultivation by Maasai pastoralists was increasing substantially in areas close to established cultivators. In the NCA where policies do not favour in-migration, the importance of in-migrants and non-Maasai population sub-groups remains in border areas, and, to some extent in areas with long history of cultivation (e.g. Endulen), probably because of the relatively easier penetration (to these areas from outside the zone). Otherwise, small-scale cultivation by resident pastoral Maasai remains to be the main form of cultivation in this zone.

Family size and labour availability in a household (determined by age structure) were important in influencing the size of cultivated land. Where a household could afford hired labour (for cultivation), its impact was significant.

Methods of farming and crop management practices for the traditional crop in the area (maize and pulses commonly cultivated for food) do not vary much between population sub-groups of different socio-economic characteristics. However, new crops in the study area are linked with in-migrants and non-Maasai. These were market-oriented crops, suggesting the different purposes of cultivation between in-migrants and non-Maasai on one hand, and the resident pastoral Maasai on the other.

CHAPTER 7

TRENDS IN POLICY AND CULTIVATION

> "The security of wildlife is inherently tied to that of its natural habitat. In this regard, game controlled areas which limit hunting but do not restrict development or otherwise control land use are essentially meaningless" (Parkipuny, 1991:20).

7.1 Introduction

It has been shown in chapter 5 that cultivation is increasing in the study area, although with important inter- and intra-zonal variations that reflect the influence of both ecological conditions and conservation and development policies in vogue. Spatial and temporal variations with regard to the magnitude of rangeland conversion are also observed between and within population sub-groups of similar as well as different socio-economic and cultural backgrounds. These observations signify the existence of important relationships between development and conservation policies and practices and the on-going conversion of the rangelands in the study area. The relationships and associated processes however, remain to be established. This chapter examines trends in various development and conservation policies and practices alongside trends in cultivation up-take. It also examines the different processes through which the policies have influenced the conversion of rangelands into croplands. The analysis focuses on temporal and spatial trends in the following policy areas:

1. Development and conservation policies/practices that subject the rangelands to conversion.
2. Land tenure: Control and access to land resources
3. In-migration

The chapter uses three levels of data: Survey data from both the heads of the 206 sample households and the 560 individual respondents (in the 206 sample households), KI discussions/interviews and, qualitative information from discussions with in-migrants. These are used alongside archival data from district files, and analyses resulting are presented in tables, graphs and in other qualitative forms. Where applicable, data from sites surrounding Loliondo township in the LGCA (Wasso, Sakala and Ng'arwa), herein denoted as LGCA centre, is compared with that from sites in the more remote areas (Ololosokwan and Arash), denoted as LGCA periphery. This is because LGCA appears to be growing into two distinct land use units (see chapters 5 & 6), where motives/factors for, and the need to adopt cultivation may differ significantly between population sub-groups of otherwise comparable characteristics.

7.2 Development and conservation policies

NCA and LGCA pursue different and sometimes conflicting development and conservation policies and practices/strategies (see chapter 3). At the same time, the two zones exhibit substantial differences in the levels of rangeland conversion to cultivation. This is clearly substantiated in the observed differences in size of converted land (chapter 5) and the varied relative contribution of different population groups and sub-groups (Chapter 6). This section focuses on the influence of three policy areas in the process of rangelands conversion, namely, settlement schemes and related policies/regulations, incentives (and limitations) to increase cultivation, and, commercial cultivation projects.

7.2.1 Settlement schemes

Several settlement schemes and operations have been enacted in the study area since (and prior to) 1975. These have resulted into the present-day permanent settlements[100], which are linked, in some way, with increasing cultivation in the study area (TWCM, 1993; MTNRE, 1995). Except for Ng'arwa village, all of the study sites involved in this study were either traditional[101] or established in the era of villagisation (*emparnati*). Settlement in Ng'arwa started in 1978 (with two households from Sakala), and the village was not registered until after 1984 when the number of households had reached the minimum requirements for village registration (not less than 150 households). Appendix 7.1 lists among other policy events, all the settlement (and resettlement) schemes effected in the study area since 1959.

For the purpose of this study, people who were born in the study sites or were living there before 1976 or were born in the study sites after 1976 are considered as residents. Those migrating into the study sites after 1976 but were living or

[100] These permanent settlements have brought together the then scattered people from within and outside the study area.
[101] Traditional settlements are here defined loosely to mean all settlements that evolved spontaneously prior to the 1976 villagisation scheme. As more people joined these settlements during the 1976 villagisation scheme, they were then registered as *Ujamaa* villages.

born in other villages within the zone are considered as residents in the zone, but new settlers in the village. Those who migrated to these sites from outside the study area (i.e. from outside the two zones) after 1975 are considered as in-migrants. Table 7.1 disaggregates settlement data by place of origin so as to reflect a general picture of settlement patterns and in-migration in the respective zones and study sites.

Table 7.1 Settlement in the study sites by place of origin

Village		Where household lived before present settlement				
		In this village	Villages in this zone	In the other zone	Outside Study Area	Total
Nainoka	Count	13	7	1	3	24
	% within Village	54.2%	29.2%	4.2%	12.5%	100.0%
Endulen	Count	12	7	2	5	26
	% within Village	46.2%	26.9%	7.7%	19.2%	100.0%
Oloirobi	Count	20	1	2	2	25
	% within Village	80.0%	4.0%	8.0%	8.0%	100.0%
Nayobi	Count	14	4		5	23
	% within Village	60.9%	17.4%		21.7%	100.0%
Sakala	Count	9	6	2	8	25
	% within Village	36.0%	24.0%	8.0%	32.0%	100.0%
Wasso	Count	3	6	2	17	28
	% within Village	10.7%	21.4%	7.1%	60.7%	100.0%
Ng'arwa	Count	4	14		2	20
	% within Village	20.0%	70.0%		10.0%	100.0%
Ololosok	Count	8	5	2	6	21
	% within Village	38.1%	23.8%	9.5%	28.6%	100.0%
Arash	Count	5	4	5		14
	% within Village	35.7%	28.6%	35.7%		100.0%
Overall	Count	88	54	16	48	206
	% within overall	42.7%	26.2%	7.8%	23.3%	100.0%

7.2.1.1 Settlement trends in NCA and LGCA

Settlement trends in the NCA and LGCA are presented in Fig. 8.1a and 8.1b respectively. According to Fig. 8.1a, the majority of the respondents in the NCA were born in the respective villages or lived there before 1976, and a reasonable proportion settled between 1976 and 1985, following the process and enactment of villagisation policy[102]. Very few settled in these villages between 1986 and 1991 when cultivation ban was in effect, but the proportion increased significantly after 1991, following the lift on cultivation ban[103].

The LGCA (Fig. 8.1b) had a pattern of opposing trends between LGCA centre and periphery. In the sites surrounding the LGCA administrative centre, the trend was generally one of a gradual increase in the number of settling households. Significant spikes are observed in Wasso in 1986/1991, and in Ng'arwa after 1991. In Sakala, a cultivation niche prior to 1975, settlement is relatively stable, with only a small, gradual increment. Both Maasai and non-Maasai were moving into this site[104]. Ng'arwa, a village dominated by Maasai, showed gradually increasing spikes, with significant increases after 1991. About 40% of the sample households settled here after 1991.

[102] This could be over-reporting to justify residence. The contemporary NCA policy does not allow non-residents in the NCA, the definition of whom was not clear among the respondents.
[103] Cross-referenced information between year of settlement and where olmarei lived before suggest that the majority of people from within the zones who were settling in these sites were coming from villages that were inhabitable because of social and/or ecological problems (e.g. cattle rustling and/or wildlife related diseases such as MCF).
[104] Data on where households lived before suggest that those settling in these sites originated from villages in the peripheral LGCA and also from outside the district.

Fig. 8.1a. Year of settlement, NCA

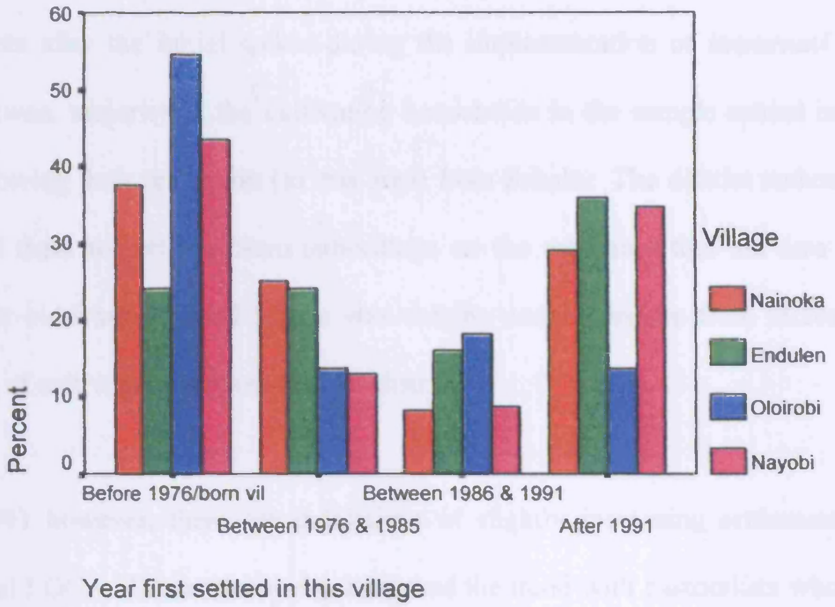
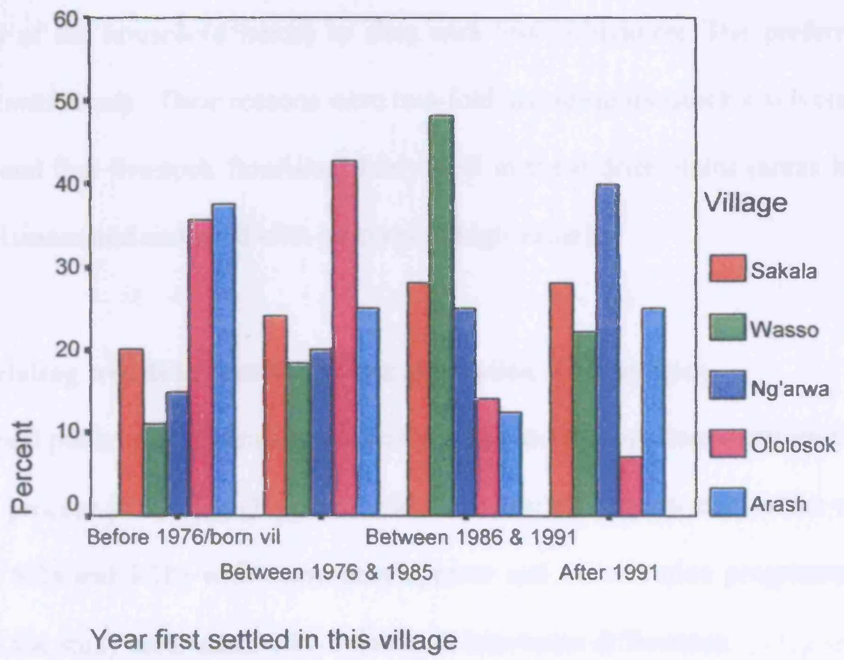


Fig. 8.1b Year of settlement, LGCA



In the peripheral LGCA, the trend was one of diminishing increment in settlements after the initial spikes during the implementation of ***imparnati***. In Ololosokwan, majority of the cultivating households in the sample settled in the area following their relocation (to this area) from Sakala. The district authorities relocated them to settle in Sero sub-village on the argument that the area was viable for cultivation[105], and Sakala was coming under pressure from increasing numbers of cultivators from outside the district[106].

After 1991 however, there are indications of slightly increasing settlements in peripheral LGCA. Discussions with KI linked the trend with pastoralists who had prospered in both cultivation and livestock numbers within LGCA centre. These tended to split their households, such that one of them would migrate (with a large proportion of the household herds) to sites with less cultivation. The preferred settlement was Arash. Their reasons were two-fold: avoiding livestock-cultivation conflicts, and that livestock flourished fairly well in these drier plains (areas less prone to diseases and endowed with pastures of high value).

7.2.1.2 Relating trends in settlement and cultivation with policies

The temporal patterns of settlement and cultivation present important overlaps that relate the process of settling (Fig. 8.1a and 8.1b) and subsequent cultivation up-take (Fig. 8.2a and 8.2b) with some development and conservation programmes enacted in the study area, albeit with significant inter-zone differences.

[105] There is considerable evidence in literature that this area is/was an important corridor for migratory ungulates (see for example TWCM, 1993; MTNRE, 1995).
[106] Pers. Comm; District Agricultural and Livestock Development Officer, Ngorongoro.

In the NCA, spikes in years of settlement overlap with year of cultivation in a way that reflects two major policy practices: villagisation scheme of the mid-1970's and the lift on cultivation ban after 1992. Short spikes showing non-significant cultivation overlie the spikes in year of settlement up to 1976. The period between 1976 and 1991 registered settlements, but without significant cultivation. This was the period of cultivation ban. After the lift on cultivation ban, there is an increase in settling households alongside significantly sharp spikes of households starting cultivation. These overlaps, and particularly the sharp spikes for households starting cultivation (all households compared to only a few in 1975/76) signify the increasing role of cultivation to the livelihoods of NCA pastoralists. This significant increase in cultivation up-take support the allegations that the ban on cultivation created subsistence gap among NCA pastoralists in terms of grain supplies, and consequently impacted on the size of household herds[107].

In the LGCA, settlement and cultivation patterns reflect several development projects and programmes, namely, villagisation programme, barley project, development of Wasso area into an administrative centre, and, deliberate efforts and incentives for cultivation from the district administration. Spikes in year of settlement in Wasso (Fig. 8.1b) make a generally perfect overlay with spikes in 'year of first cultivation' (Fig. 8.2b). This time period also concur with the development of Wasso township into an administrative HQ for Ngorongoro district, as well as the period of commercial cultivation of barley in the area

[107] Potkanski (1996) and Mc Cabe (1997) substantiates livelihood stress in this period through data

(1986/87 – 1992/93). The barley project ceased in 1992/93, and only a few households in the sample settled in the same village after 1991. Similarly, only a few started cultivation after 1991.

With such trends, and given that barley cultivation started in 1987 and ceased in 1992/93, we can therefore conclude that majorities of households settling in these sites during the period of barley cultivation were doing so strategically as cultivators. Their main motive was to benefit from involvement in barley cultivation, and also to exploit other benefits associated with the barley project.

In Ng'arwa, more households were settling during the 1990's following incentives from the Ngorongoro district administration[108] to promote cultivation among Maasai residents. Ng'arwa is a village where Maasai pastoralists were cultivating at significant levels that may result to important transformations in their production system. Authorities and key informants (KI) in this village reported that many pastoralists coming to settle in the village were doing so for the purpose of cultivation. They included pastoralists of different wealth categories - the rich, medium and the poor.

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on inadequacies in grain supplies and unsustainable off-takes that included sales of lactating cows!

[108] The district Agricultural Officer informed of deliberate efforts to promote cultivation of food crops in the zone, and this was accompanied by incentives like the provision of ploughs and other farm inputs at a subsidised cost, and competitions on agricultural performance where the best village was awarded annually. Ng'arwa village received this award twice in two consecutive cultivation seasons (1995/96 and 1996/97). Note: Each year, Tanzania celebrates Farmers' day, where the best village (of the year) in agricultural performance is awarded.

Fig. 8.2a. Year started cultivation, NCA

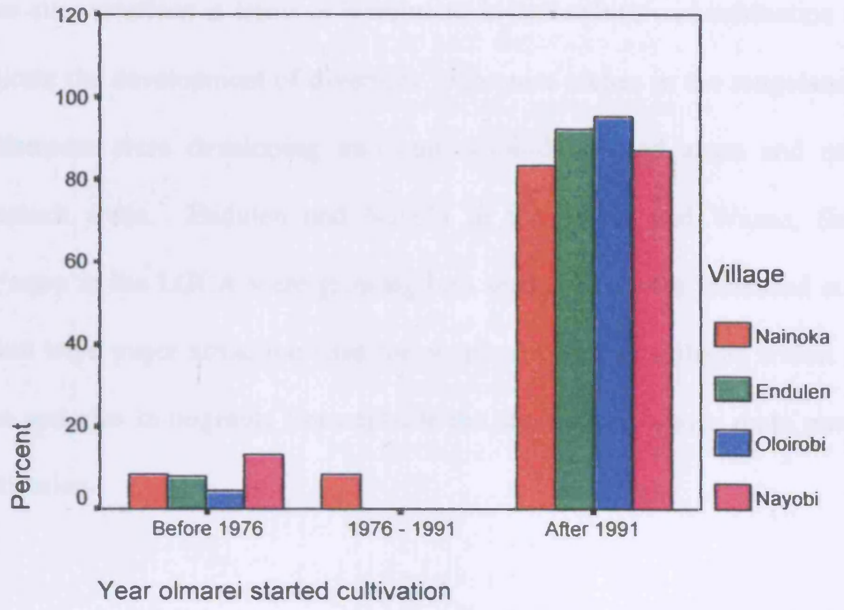
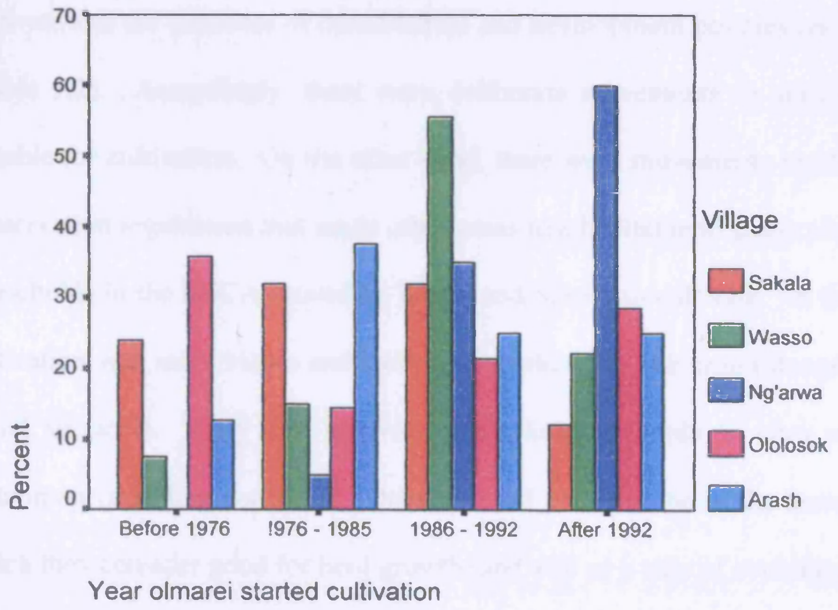


Fig.8.2b Year started cultivation, LGCA



7.2.1.3 Spatial patterns of settlement and cultivation

Inter-site variations in terms of increments in settlements and cultivation over time indicate the development of divergent settlement niches in the rangelands. Some settlements were developing into cultivation-dominated areas and others into livestock areas. Endulen and Nayobi in the NCA, and Wasso, Sakala and Ng'arwa in the LGCA were growing into settlements with increased cultivation. These were major attraction sites for people from other villages within the study area and also in-migrants from outside the study area, whose main purpose was cultivation.

This economic dichotomy was ascertained through discussions with village government officials and traditional Maasai elders in different study sites. Discussions on why people were migrating to their villages (from other villages in the study area) linked the emerging settlement clusters with both the need to cultivate and the influence of conservation and development policies and practices (Table 7.2). Accordingly, there were deliberate movements to sites (villages) suitable for cultivation. On the other hand, there were movements resulting from conservation regulations that made other areas less habitable to pastoralists. Some households in the LGCA moved to Wasso and Sakala to cultivate. In these areas cultivation was more viable and had ready markets for the crop (alongside other social services). They can cultivate while keeping herds in sites with little cultivation (avoiding conflicts). Others would prefer to be in the remote areas, which they consider good for herd growth, and also as a way of avoiding potential conflicts in the emerging crop-livestock mode of land use.

Table 7.2: Reasons for settling in the study sites (from within the study area)

Zone	Site	Who and why settle in your village (from other villages)
NCA	Endulen	▪ Households that have lost their cattle settle to cultivate if they do not have good land for the purpose in place of origin, mainly from Kakesio (NCA). ▪ Some individuals coming back to the lands they cultivated prior to the 1975 cultivation ban. ▪ Those avoiding cattle rustling and MCF at origin[109].
	Nainokanoka	▪ Some individuals evicted from other areas in the zone[110] ▪ Those avoiding cattle rustling and MCF at origin (mainly those from Kakesio in the NCA).
	Nayobi	▪ Cultivators evicted from other areas in the zone. ▪ Some cultivators coming back to the lands they cultivated prior to the 1975 cultivation ban[111].
LGCA	Sakala/Wasso	▪ Residents from remote areas in the zone, following social services and cultivation ▪ In-migrants from outside the district, following relatives and land for cultivation.
	Ng'arwa	▪ Pastoralists from the zone, coming to cultivate, increase wealth.
	Ololosokwan	▪ NA. Not many in-migrants, very few.
	Arash	▪ Wealthy pastoralists from areas with significant cultivation in the LGCA (Wasso, Sakala and Ng'arwa); livestock flourishes better in the lowlands than in the highlands; would like to avoid conflict with cultivators

In the NCA, most pastoralists were residing in the highlands where cultivation is limited by ecological conditions. The main reasons were avoidance of areas with MCF and cattle rustling[112], and a few (from Nayobi) were avoiding conflicts with cultivators following the increase in cultivated areas after the lift on cultivation ban. There were however, two non-Maasai households in Nainokanoka and Oloirobi who had come to their inherited farms (after lift on cultivation ban).

[109] Incidents of cattle rustling and MCF were reported to increase following settlement schemes that resulted to some large tracts of rangelands to remain without people.
[110] Areas commonly named were Ngorongoro Crater and Lemala, the present location of Sopa Lodge.
[111] Some households in this site simply changed land uses following cultivation ban. During the ban, they grazed the lands within the NCA and settled and cultivated the lowlands they occupy just outside the NCA. After the lift on cultivation ban, they returned to settle and cultivate inside NCA, and grazed the lowlands outside the NCA.
[112] Majority were coming from Kakesio and Olbalbal in the NCA. MCF and cattle rustling are a common problem in these areas (Kikula, 1998; MTNRE, 1995).

The spatial patterns (of settlement and land-use) resulting from the above settlement schemes are assumed to be influenced by temporal changes and developments in other conservation and development policies in the study area. In the NCA for example, the effects of the ban on the use of fire in the management of pasture and parasites have rendered some areas in the rangelands to be less habitable to pastoralists (Kiwasila and Kauzeni, 1999; Mung'ong'o, 1997). Zoning off of some areas (e.g. the northern highlands), or development of new tourist facilities (e.g. the construction of hotel facilities) imply further resettlements. In the LGCA, commercial cultivation and efforts to promote cultivation in some sites may lead to increased settlements in sites considered favourable for cultivation at the expense of those considered less favourable.

7.2.2 Incentives and/or controls for rangeland conversion

Converting rangeland to cropland demands tools/machines like tractors, hoes, etc. for the initial clearing of land and the initial breaking of the soils. Moreover, the crop to be produced in these lands demand inputs like seeds, fertilisers, pesticides, etc. Also, availability (or lack) of credits and technical advice on crop-production in these rangelands is assumed to contribute significantly to the magnitude of rangeland conversion. This section compares the two zones with respect to incentives/controls for the conversion of the rangelands.

7.2.2.1 Availability of tools and other inputs for cultivation

The type of tools used in the preparation of fields (including tilling of the land) before sowing plays a major role in determining the size of farm a household would be able to cultivate and plant in time. Under the prevailing conditions of soils and rainfall availability in the study area[113], cultivators who use the hand hoe are limited in terms of size of land they are able to timely put into cultivation. On the other hand, and other factors remaining constant, cultivators who can use efficient tools like the ox-plough[114] may increase the size of their farms according to the needs of the household. Plate 7.1 shows tilling of land using an ox-plough in Ng'arwa village.

Plate 7.1 Tilling of land using an ox-plough, Ng'arwa village (Jan. 1999)

[113] The area is characterised by erratic rainfall, sometimes with late onsets or short-lived. It demands a timely sowing, obviously preceded by a timely preparation of the fields. Some areas have loamy soils (e.g. Endulen) that are not quite easily cultivated using the hand hoe.
[114] Ox-ploughs are used in tilling and harrowing the land, and can till approximately two acres in three days

There were considerable differences in the availability and use of different tools and inputs for cultivation between and within the two zones. Table 7.3 compares the two zones in terms of ownership and use of ox-ploughs for cultivation. It shows mean number of oxen ploughs owned and used by sample households in the 1998/99 season in the two zones (N = 206).

In the NCA, none of the households reported owning or using a plough. The only tool allowed was the hand hoe. This was owned and used by all cultivating households in the sample. Every cultivating household owned one or two hoes, with a few owning more than two. The implication is that majority of the households in the NCA are limited in terms of size of land they may wish to put into cultivation because of poor, inefficient tools.

Table 7.3: Ownership and use of oxen ploughs in sample households by zone

Ox-ploughs		NCA (N = 98)	LGCA (N = 108)
Ownership:	Did not own	98 (100%)	92 (85%)
	Owns 1	0 (0%)	13 (12%)
	Owns 2 or more	0 (0%)	3 (3%)
	Total	98 (100%)	108 (100%)
Use:	Did not use	98 (100%)	63 (58%)
	Used	0 (0%)	45 (42%)
	Total	98 (100%)	108 (100%)

The situation was different in the LGCA. In addition to hand hoes owned by all cultivating households in this zone, there were 19 oxen ploughs owned by 16 of the cultivating households in the sample (three of the households owned two ploughs each; the rest owned one each). These ploughs were accessible to other households (normally within the village/site) through hiring and sharing. As a result, about 42% of the sample households in the LGCA reported to have used ploughs in the 1998/99-cultivation season. This figure is significant because the ploughs owned (and used) were concentrated in only three sites – Sakala, Wasso and Ng'arwa. It implies that tools are not a constraint in these sites when a household decides to increase cultivation. This is one of the reasons for the generally larger farms per household in the LGCA compared to the NCA.

Ploughs were not reported in Arash, and only one was reported in Ololosokwan (in Sero sub-village). However, the small scale of cultivation observed in these sites alongside the less favourable ecological conditions (in terms of cultivation) does not suggest need for a significant increase in the near future.

7.2.2.2 Incentives from district administration

In chapter 3, it was alleged that there were deliberate efforts from within the district administration circles to promote cultivation in the LGCA. In this study, KI discussions and archival data from Loliondo district files were analysed to examine the allegations. A summary of the information obtained (Table 7.4), although confined to NCA only, it fairly substantiates the impression that there are deliberate efforts from the district administrative circles to increase cultivation in the LGCA. The forces are directed to both small- and large-scale cultivation by prospective farmers from outside LGCA, residents and in-migrants alike. It practically differentiates the two zones in terms of influence of policies in rangeland conversion in the sense that there was no such information for NCA

Table 7.4: Influence of the District administration on increasing cultivation

Source	Information/observations
Pers. Comm. (19/08/99) with: 1. District Agricultural and Livestock Development Officer (DALDO); 2. District Crop Officer (DCO).	Both DALDO and DCO view cultivation as increasing in the LGCA. More households involved (esp. Maasai households); larger acreage per household; better yields per unit of land. Attributes the increase to: ▪ Provision of extension services and training to farmers in areas around Loliondo township (Sakala, Wasso, Ng'arwa and Orkiu) and other LGCA areas with good agricultural potential esp. Enguserosambu. ▪ Farmers' adoption of modern farming techniques (in some of the areas mentioned above) as a result of training and technical assistance from the district's agricultural extension workers.
Ole-Kukuyet, (Chairman, of Ng'arwa village), pers. Comm. (21/08/1999)	▪ Commends the district authorities for the improvements in cultivation achieved in his village. The village won the trophy for the best village in crop production activities in the district for two consecutive years (1995/96 and 1996/97)[115] ▪ Visitors' book shows that the village is visited regularly by officers from the district HQ who encourage and train on cultivation
District Planning Officer (DPO); pers. Comm. (28/08/99)	▪ Informs that there are, in the district files, requests for lease/allocation of large tracts of land for cultivation (ranging from 20 to 100 hectares) by people from outside the district. The respective committee had discussed some of the requests, some had been granted, and some were awaiting discussion[116].
File (A/FAM/AR/Loliondo), titled: Famine Reports and correspondence	Contains an annual report that lays down several strategies of alleviating the problem of food insecurity in1997/98. Those promoting cultivation include: ▪ Economic empowerment of farmers and agents of agricultural inputs through provision of credits so that they can buy the inputs. ▪ Enhancing cultivation of cash crops among farmers as a means of cash generation.
File (A/AG/TR/Loliondo), titled: Malengo ya Kilimo	Contains several reports that indicate: ▪ A gradual increase of land targeted for cultivation (4389 hectares in 1982/83 to 10266 hectares in 1998/99, with a peak of 14845 hectares in 1991/92 – the hey-days of barley) ▪ Plans for the procurement of various agricultural implements and inputs to include ploughs, hoes, seeds, pesticides and fungicides. ▪ Plans to ensure that extension services reaches a large proportion of farmers (13400 farmers targeted in 1997/98)

[115] See footnote 108

[116] See Box 7.2 for land application procedures

Promoting small-scale cultivation, and particularly when the target population is resident pastoralists, can fairly be interpreted as efforts to alleviate the problem of food insecurity in the area. Moreover, the resultant cultivation (small-scale) can be integrated into the existing livestock-wildlife land uses with minimal adverse effects on the range resources. However, this is not the case with large-scale cultivation. Discussions (with some KI) on barley cultivation of mid- 1980's and early 1990's suggested that promoting large-scale cultivation in the LGCA may not necessarily benefit the resident pastoralists.

Firstly, those requesting land for this scale of cultivation were entrepreneurs cum land speculators from outside the district, who could also opt for markets elsewhere (in light of trade liberalisation). It is in this context of large-scale cultivators from outside the zone that the conception of LGCA as a future granary of Tanzania by the district authorities was born.

Secondly, KI in the villages of Mundoros and Enguserosambu reported that large-scale cultivation was interfering with range resources of significant importance to both livestock and wildlife. The cited the TBL farm, the western part of which was reported to have engulfed an important corridor for migratory ungulates, including those animals that happen to be left behind during migration. This is a wet corridor along the ***Pololet*** river, stretching in a SW - NE direction through the northern plains towards Kenya (Map 2). Own observations (three visits during the dry seasons of 1997/98 and 1998/99) support the KI reports. In each visit, several of the ungulates were found wandering in the area. Plates 7.2 and 7.3 show different ungulates spotted during the visits.

Plate 7.2 Migratory ungulates along Pololet river (edge of TBL farm), May, 1998

Plate 7.3 Migratory ungulates along Pololet river, July 1999

7.2.2.3 Influence of policies on size of farms among cultivating individuals

Continued conversion of the rangelands is partly dependent on individuals' decisions to increase their cultivation. However, their decisions are influenced differently by the policies in vogue. All the 560 respondents in the 206 sample households were asked whether or not they intended to increase their cultivation, and reasons for their answers[117]. Their responses are presented in Table 7.5.

Table 7.5: Increasing cultivation next season and reasons for not increasing.

Whether intends to increase cultivation next season	Zone				Total	
	NCA		LGCA			
	N	%	N	%	N	%
NA. Intends to increase	108	41.6%	111	37.0%	219	39.1%
Not stated, not decision maker	37	14.2%	44	14.7%	81	14.5%
Do not intend to increase	115	44.2%	145	48.3%	260	46.4%
Total	260	100.0%	300	100.0%	560	100.0%
Reasons for not increasing cultivation						
Inadequate labour	33	12.7%	24	8.0%	57	10.2%
Have enough under cultivation			8	2.7%	8	1.4%
Restrictions (conservation laws)	29	11.2%			29	5.2%
Lack of land	45	17.3%	55	18.3%	100	17.8%
Not stated	8	3.0%	21	7.0%	29	5.2%
Not paying (low yields)			37	12.3%	37	6.6%
Total (of not intending to increase)	115	44.2%	145	48.3%	260	46.4%

According to Table 7.5, about 39% of the respondents said they intended to increase the size of their cultivation in the next season, and 46% said they did not intend to. The remaining 15% could not make a statement because they are not decision-makers (particularly where decisions about cultivation are made at household level). Although the proportion of those intending to increase their

[117] This question was asked to all 560 respondents in the 206 households. They have different decisions.

cultivation is slightly smaller than that of those who do not intend to increase, the net outcome will be more land converted to cultivation.

Overall, the main reasons given by those who do not intend to increase their cultivation revolve around four main factors: availability of land (18%), labour availability (10%), suitability of the rangelands for cultivation where the activity was reported as 'not paying' (7%), and restrictions by conservation laws (5%). A few did not want to increase cultivation because they already had enough under cultivation.

The meaning and importance of some of these factors differed between the two zones. In the LGCA lack of land was defined to mean that land of good quality was not available within a reasonable distance, particularly in the village of Sakala, mainly because soils have been exhausted by continued cultivation ever since. In other areas, e.g. Arash and parts of Ololosokwan, lack of land was associated with ecological conditions. Most of these areas are too dry for meaningful cultivation. This also explains why some respondents in the LGCA argued that cultivation was not paying. Problems of land availability and unfavourable ecological conditions limit cultivation increase among 31% of the respondents in the LGCA. A further 8% is limited by labour availability.

In the NCA, lack of land and restriction by conservation laws imply restricted access to land resources by the NCAA. The NCAA law allows a maximum of one acre per sub-household. This is assumed to be able to supplement food requirements in the pastoral sub-households, at the same time keeping the scale of cultivation in the zone as low as possible. Therefore lack of land due to restrictions by conservation laws limits cultivation increase among 29% of the respondents. A further 13% is limited by labour availability, which is in part, associated with restrictions on in-migration.

In general, much of the potential increase in rangeland conversion in the NCA is controlled through restrictions imposed on cultivation by the NCAA. Otherwise, more people would convert more land into farms. In the contrary, the only limitations in the LGCA are those related with availability of suitable land, labour resources, transport infrastructure and markets. Otherwise, there are no deliberate measures to control the conversion of the rangeland to cultivation. Instead, there are efforts to ensure that every household cultivates at least two acres[118].

7.2.3 Development/economic projects

There are several development projects in the study area that were found to be linked in some way or another with increasing cultivation. Some are cultivation oriented, some are tourism oriented and others oriented to socio-economic development e.g. schools. Their contribution in the increasing cultivation is examined below.

[118] Pers. comm. District Crop Officer, 17/09/99.

7.2.3.1 Cultivation oriented projects

Large-scale commercial cultivation introduced in the rangelands and the associated motivations like tractors, seeds etc.[119] are an important motivation for accelerated rangeland conversion. Despite the large tract of rangelands converted to cultivation by the projects, the associated benefits like developments in infrastructure and markets are linked with an influx of opportunistic migrants who convert more land.

In this study, commercial cultivation of barley introduced in LGCA by TBL in 1986/87 is a typical example. TBL had acquired a 400Ha farm in the locality of Sukenya and started barley cultivation in 1986/87, initially bringing into cultivation a total of 92 Ha. From 1988/89 there were several contracted growers (individuals) selling their produce to TBL. This resulted into more farms being opened around the TBL farm and in adjacent villages by individual entrepreneurs (alongside the gradual increase of TBL land coming under cultivation). The project ceased in 1992/93 following two consecutive drought years. However, by the time of TBL withdrawal, land under barley production had increased ten-fold within seven years (Table 7.6). The contractors were mainly outsiders, cultivating reasonably large tracts of land[120]. Indigenous Maasai pastoralists had started to

[119] Source: District file No. A/AG/TR/Loliondo.

[120] District files provide evidence of individuals who had requested up to 100Ha, and some who had been allocated up to 60Ha. Most of them were recognised to be non-Maasai (by virtue of their names and other bio-data).

join slowly, but unfortunately for most of them, coinciding with the drought years of 1992/93 which led to the withdrawal of TBL from cultivation in the area[121].

Table 7.6 Trends in land converted for barley production in the LGCA (1986 – 93)

Year	Ha	Yield (t)	Comments/remarks
1986/87	92	69.9	First large scale barley cultivation
1987/88	no data	no data	
1988/89	320	no data	First individuals (non-Maasai from outside LGCA) join in the cultivation of barley, selling it to TBL
1989/90	500	429.0	More individuals (non-Maasai) join
1990/91	747	348.9	
1991/92	1402	no data	First Maasai individuals join; total yield not recorded but very low; drought
1992/93	1080	10.0	Very poor yield; drought and erratic rains
1993/94	0	0	TBL did not cultivate. Withdrawn.

Source: District files, Ngorongoro district HQ.

Further evidence that links development projects with increasing cultivation in the rangelands is the abandonment of farms which were once under barley in the LGCA (Table 7.7). Collapse of the project due to adverse weather among other factors meant that markets, tools and other inputs and incentives for the crop were no longer available. Consequently, the majority of the opportunistic in-migrants abandoned the lands and left the district.

By the time of this survey, most of the contracted individuals had migrated out of the district. Only a few were available for interviews in Wasso and Sakala, and they reported an average of 8.13Ha as land they had abandoned or fallowed since 1993/94, following the withdrawal of TBL (Table 7.7). Statistics from the district

[121] By the time TBL withdrew, about five Maasai households were participating in this commercial barley production (Ngorongoro District Agricultural Development Officer, Pers. Comm. 16/08/1999).

authorities suggest that over 600Ha of barley were cultivated in the LGCA by these enterprising individuals. On the other hand, very few individuals (8 households) and very little land was under fallow in the NCA.

Table 7.7 Fallowed/abandoned land since 1995

Zone	Sites	N	Mean	Std. Deviation
NCA	Endulen & Nayobi	6	0.8333	0.4378
	Nainokanoka & Oloirobi	2	1.7500	1.7678
LGCA	Sakala + Wasso	16	8.1250	7.8177
	Ololosokwan & Arash	3	1.0833	.5204
Overall		27	5.2500	6.9261

7.2.3.2 Tourism related projects

The pace of construction of tourist hotels and other facilities retarded after Arusha declaration. However, trade liberalisation of the early 1990's changed the situation. In 1991 and 1996, two tourist hotels - Sopa Lodge and Serena Hotel - were constructed in the NCA.

The two hotels are linked with increasing cultivation on the assumption that they provided markets for part of the vegetable cultivated in areas within their vicinity. Information obtained from hotel authorities supported the assumption. The hotels were buying vegetable from some farmers in quantities ranging from between 30 and 40 Kg/day to 40 – 60 Kg/day per hotel depending on the number of tourists. Two respondents among five individuals who were supplying the hotels with vegetables as presented in Box 7.1 further substantiated this information. Despite their limited number they give an indication of the contribution of these hotels in the increasing cultivation and the categories of people involved.

Box 7.1: Influence of tourist hotels in increasing cultivation

Respondent No. Age: 29; Education: 'O' level; Ethnicity: Arusha; Residential status: Migrant.

- Resides in Nainokanoka, sells vegetable to Sopa Lodge twice a week (routine).
- Sold different types of vegetable in 1999. Common ones were cabbage, carrots, spinach, lettuce and cauliflower. The price was fixed – 200 TShs/Kg for all types of vegetable except cauliflower, which was sold at 400 TShs/Kg.
- Vegetable came from different sources because the respondent could not meet the demands from own cultivation. Priority was in vegetable from own cultivation, then from friends (who had to pay a token whenever given the opportunity to sell in the respondent's name), and lastly from other cultivators who sold their vegetable to the respondent at a negotiable price, usually less than 100 Tanzanian shillings per Kg.
- Made an income of 364200 TShs (approximately USD 506 by prices of 1999) in the period of January – September 1999 from vegetable sales to Sopa Lodge alone[122].

Respondent No. Age 24; Education: 'O' level; Ethnicity: Meru; Residential status: Migrant.

- Resides in Oloirobi; sells vegetable of different types to Serena Hotel, no defined schedule.
- Price varies with availability of vegetable, between 200 and 300TShs/Kg.
- Obtains vegetable from own cultivation, cultivation by other members of the household, and, when in short supply, purchases from other individuals at negotiable, low price.
- The entire household made an income of 551600 TShs (approximately USD 766 by prices of 1999) in the period of January – September 1999 from vegetable sales to the Hotel.

7.3 Land tenure: Control/access to land resources

Literature shows that traditional cultivation by Maasai in the study area was small in scale, confined to small plots around the homestead (Gulliver, 1953), and permission to cultivate a new farm was obtained from the elders of the boma (Ndagala, 1992). This could be interpreted as traditionally planned cultivation that did not interfere with pastoralism (and equally, wildlife). New means of access and consequent control over land resources are therefore assumed to create a situation where opportunistic land seekers may come in and convert the rangelands, and, over time, bring in ideas and perceptions of land resources as private property.

[122] By this time, the starting salary of a freshly qualified primary school teacher was TShs. 670800/= pa, approximately 700GBP by prices of 1999.

This section explores the means of land acquisition in the area trying to examine the relative influence of the changing control over land resources in driving the conversion of rangelands. It is based on survey information covering a total of 544[123] farm plots that were owned by 188 cultivating households in the sample. Some were owned as olmarei plots and others as enkaji or individual plots.

7.3.1 Methods of land acquisition in the study area

The 544 plots were acquired through a wide range of methods (Table 7.8). Two methods, namely allocation by VGT and customary use[124] were dominant. They accounted for the acquisition of 41% and 35% of all the plots in the study area. Next in importance was inheritance[125], accounting for 11% of all the plots. Four other methods accounted for the acquisition of the remaining 13% of the plots. These were conversion of old cattle pens (into farms), relatives and friends, borrowing and purchasing.

The order of importance of the various methods is generally similar for both zones except for the proportion of plots acquired by converting cattle pens. Such conversions accounted for approximately 9% of all the plots in the NCA compared to less than 1% in the LGCA. Condensing the data into four variables (allocation by VGT, customary use, inheritance and "other methods" which constitute the last four variables), a chi-square test was run and it showed that the

[123] Includes individual plots of all 560 respondents in the 260 sample households.
[124] Customary use is here defined loosely to mean cultivation of land around households or any other area without formal permission from VGT. It refers to fields acquired under traditional (pastoral) means, i.e. under permission of boma elder.

observed difference (in importance of the methods) discussed above was statistically significant (Chi-square = 16.324; $p < 0.001$; df = 3).

Table 7.8 % distribution of plots by means of acquisition

Method of land acquisition	NCA (N = 256)	LGCA (N = 288)	Overall (N = 544)
Allocation by VGT	(109) 42.6%	(116) 40.3%	(225) 41.4%
Customary use	(72) 28.1%	(117) 40.6%	(189) 34.7%
Inheritance	(41) 16.0%	(20) 6.9%	(61) 11.2%
Conversion of old cattle pen	(22) 8.6%	(2) 0.7%	(24) 4.4%
Borrowing	(6) 2.3%	(15) 5.5%	(21) 3.9%
Given by relatives/friends	(5) 2.0%	(11) 3.8%	(16) 2.9%
Bought	(1) 0.4%	(7) 2.4%	(8) 1.5%
Total	(256) 100.0%	(288) 100.0%	(544) 100.0%
Chi-square test results*	Chi-square = 16.324; p = < 0.001; df = 3		

N = Number of plots
* Chi-square test is based on a 2 by 4 table (the last four methods are collapsed into one).

Most of the methods were however, represented differently between the two zones. With regard to the two dominant methods, allocation by VGT overrides customary use in the NCA. It accounts for 43% of the plots compared to 28% acquired through customary use. This difference may be explained by conservation regulations in the zone whereby the NCAA (in collaboration with village leaders and elders) delineates land for cultivation (as cultivation blocks), and the VGT divides these blocks to individuals. The initial allocation of cultivation blocks therefore considers crucial range resources, hence the interests of cultivation, pastoralism and conservation. Delineation of cultivation blocks to be divided to users leaves little room for customary use. Most of the plots

[125] Inheritance was common in sights with long history of cultivation, mainly inhabited by non-Maasai or where cultivators had been evicted and have now returned after the lift on cultivation ban in the NCA.

recorded as acquired through customary use in this zone were those very close to homesteads (including converted cattle pens), mainly planted with vegetables and potatoes.

In the LGCA, the two methods (allocation by VGT and customary use) are presented in an equally competing situation, each accounting for approximately 40% of the plots. This is a reflection of the competing influence of development policies that encourage allocation of land for cultivation by the VGT to both residents and in-migrants[126] on one hand, and that of traditional methods (customary use) among cultivating Maasai pastoralists in areas they dominate. What remains to be established is whether land allocation by VGT adequately considers important livestock and wildlife requirements within the rangelands as pastoralists would do in their traditional method.

Inheritance was more pronounced in the NCA (16%) than the LGCA (7%), probably because of the rights of occupancy to land claimed by a majority of those returning after cultivation ban was lifted[127]. They claim that their families or relatives owned and cultivated the land prior to the 1975 cultivation ban.

The long array of methods is a clear indication of a changing control over access to, and eventually use of, rangeland resources. That customary use accounted for less than 35% of all the plots acquired for cultivation shows clearly how the new

[126]Allocation by VGT is a formal procedure applicable to residents and in-migrants, whereby any individual accepted in a settlement is entitled to land of up to 2 acres upon request from the VGT.

methods have overridden the traditional ones. The situation is more threatening as the traditional method (customary use) is preceded by land acquisition through VGT, a method imposed in the area by superior political powers. Moreover, the less dominant methods, though representing only small proportion of the plots (and consequently a small proportion of sample households) suggest an emerging notion of ownership of land as private property. Inheritance, purchases and borrowing all bear the notion of private property. Conversion of an old cattle pen/boma into a farm may also be equated with inheritance[128].

The assumption that the new methods of land acquisition emerging in the rangelands may not adequately consider the interests of pastoralism and wildlife land-uses becomes more obvious when considered in relation to size of plots (Table 7.9).

Table 7.9 % distribution of plots of different sizes by methods of land acquisition

	N	VGT	Squatting	Other methods	Total
Plots ≤ 1.0 acres	390	21.8%	43.8%	34.4%	100.0%
Plots 1.0 – 2.0 acres	102	79.4%	14.7%	5.9%	100.0%
Plots ≥2.0 acres	52	61.5%	25.0%	13.5%	100.0%
Total	544	36.4%	36.6%	27.0%	100.0%
Chi-square results*	Chi-square = 132.921; $p < 0.001$ df. = 4				

N = Number of plots

* Chi-square test is based on absolute values, i.e. number of plots.

[127] The majority of respondents who had returned to the NCA after cultivation ban belonged to Waarusha ethnic group, and several had relatives in the NCA (See Table 7.12).

[128] Conversion of cattle pens/evacuated bomas into farms was common in Nainokanoka and Oloirobi. Two reasons were associated with method in these sites: One was the difficulty in opening up new cultivation plots due to dominance of *Eleusine Jaegeri* in the area, a grass species

Allocation of cultivation land by VGT resulted to individuals acquiring larger plots. It accounted for the allocation of 79% of medium plots and 62% of large plots. On the other hand, customary use put small plots in cultivation. It accounted for the acquisition of 44% of small plots not exceeding 1.0 acres. A chi-square test showed that the difference in size of plots by method of land acquisition discussed above was statistically significant (chi-square = 132.921; df. = 4; $p < 0.001$).

Larger plots are linked with increased land cover change (LCC). They are also a potential source of conflicts as they interfere with livestock movements. On the contrary, smaller plots and customary use are generally seen as reflecting the traditional Maasai small-scale cultivation.

The importance of the different methods of land acquisition also varied with residential status of individual respondents (Table 7.10).

Table 7.10 Methods of land acquisition by residential status[129] of individual cultivators

Method of land acquisition	Residents		Migrants		Total	
	N	%	N	%	N	%
Allocation by VGT	152	37.0	73	54.9	225	41.4
Squatting	174	42.3	15	11.3	189	34.7
Inheritance	51	12.4	10	7.5	61	11.2
Conversion of old cattle pen	23	5.6	1	0.8	24	4.4
Given by relatives/friends	4	1.0	12	9.0	16	2.9
Borrowing	5	1.2	16	2.0	21	3.9
Bought	2	0.5	6	4.5	8	1.5
Total	411	100.0	133	100.0	544	100.0

N = Number of plots; % = Proportion in residential status

difficult to up-root. The other is the high organic soil fertility and associated high productivity of evacuated cattle pens especially when the crop is vegetables or potatoes.

[129] See pp. 158 - 159 for the definition of migrants and residents

Accordingly, the most important method for residents was customary use, accounting for about 42% of their plots. Allocation by VGT ranked second, accounting for 37% of their plots. On the contrary, allocation by VGT was more important among migrants, accounting for about 55% of their plots. Customary use accounted for only 11% of their plots, and in most migrant cases, squatting was possible after obtaining the initial plot through VGT. Also, friends and relatives as well as purchases were more important in land acquisition among migrants than they were among residents.

From the above, we can conclude that the traditional control over land resources in the study area is declining gradually as the more modern methods integrated in the governance system overrides the traditional methods. Because they put larger plots in cultivation, they result in and encourage a cultivation mosaic that may not adequately fit in the land use designated for the area (livestock and wildlife). Moreover, the new methods are more important among in-migrants compared to residents, suggesting their contribution as one factor of attraction of in-migrant cultivators into the area.

7.4 In-migration

The two zones have different policies on migration. In the LGCA, in-migration is allowed as per national policy on internal migration[130]. In the NCA, in-migration

[130] It is stipulated in the Arusha Declaration Manifesto that alongside other human rights, every Tanzanian has the right to go to/live in any place in Tanzania, provided he does not break the law. He however has to obtain an identity note from place of origin. At destination, he is discussed by the village authorities before he is given residence and other rights (including land rights) in the village.

is not allowed. It was banned alongside the ban on cultivation in 1975. This section analyses the processes and influence of in-migration in the conversion of rangelands. It is based on both survey data and follow-up discussions with some of those identified as in-migrants.

Because of the restrictions imposed on in-migration in the NCA, only indirect approaches of studying motives for in-migration were used. Information on the place of origin of individual respondents was cross-referenced with known literature, particularly that regarding cultural occupation and availability of land resources. Then, informal, follow-up discussions/interviews with few individuals (identified as in-migrants) provided further information on motives and process of in-migration, particularly in the NCA.

Of the 560 respondents in the 260 sample households, 130 were in-migrants; people who started to live in the study area after 1975. These were distributed in the two zones as indicated in Table 7.11.

Table 7.11: In-migrants population in the sample households[131]

Residential status		Zone		Total
		NCA	LGCA	
Resident	Count	205	225	430
	% within Zone	78.8%	75.0%	76.8%
Migrant	Count	55	75	130
	% within Zone	21.2%	25.0%	23.2%
Total	Count	260	300	560
	% within Zone	100.0%	100.0%	100.0%

[131] The proportions that are observed in this study should not be taken as representing levels of in-migration in the study area. There were deliberate efforts aimed at including as many in-migrants in the NCA sample as we could so that we could use the information in analysing their contribution in rangeland conversion.

The proportion of in-migrant populations in the sample is slightly higher in the LGCA compared to the NCA (25% and 21% respectively). Given the differences in policies of in-migration in the two zones, one would expect a significantly higher proportion of in-migrants in the LGCA compared to NCA. However, the figures presented here are not (nor were they meant to be) representing the levels of in-migration in the study area. In the NCA and the remote parts of LGCA migrants were deliberately included in the sample so as to allow for analyses regarding their relative contribution in rangeland conversion. Our main concerns therefore are the motives and processes of in-migration into the study area.

Motives and origins of in-migrants

The migrants were heads of households, spouses to heads of households/heads of sub-households, and a small proportion of individuals who were relatives and/or friends of heads of households. Information on the place of origin of the migrants was assumed to provide clues of the motives for their in-migration. Table 7.12 shows the place of origin of migrants in the two zones. As expected, majority of the migrants (50%) originates from districts adjacent to each of the two zones. This proportion decreases gradually through districts next to those adjacent to the zones (27%), distant districts in the outer region (11%), to those coming from across national boundaries[132] (12%).

[132] This refers to Kenyan Maasai, within the sme ethnic, cultural and geographical continuum of the East African Maasailand. They can thus be considered as coming from an adjacent district to the LGCA, and a district next to the adjacent districts in the NCA.

Table 7.12 Origin of in-migrants in the study area (N = 130)

Origin		Zone		Total
		NCA	LGCA	
Districts adjacent to the zone	Count	34	31	65
	% within zone	61.8%	41.3%	50.0%
Districts next to those adjacent to the zone	Count	11	24	35
	% within zone	20.0%	32.0%	26.9%
Outer region, not close to the zone	Count	9	5	14
	% within zone	16.4%	6.7%	10.8%
Across national boundaries	Count	1	15	16
	% within zone	1.8%	20.0%	12.3%
Total	Count	55	75	130
	% within zone	100.0%	100.0%	100.0%
Chi-square test results*	Chi-square = 5.652; p > 0.05; df. 2			

* For a better reflection of spatial flow of in-migrants into the study area, migrants from across national boundaries into the LGCA are combined with those from districts adjacent to the zone. In the NCA they are combined with those from districts next to those adjacent to the zone (see footnote 132)

A chi-square test (considering in-migrants from across national boundaries as coming from districts adjacent to or next to those adjacent to the study zones – see footnote 132) showed that the observed variation between the two zones in terms of origins of in-migrants was not statistically significant at p 0.05 (chi-square = 5.652; p > 0.05; df = 4). The lack of significant variation is partly explained by the nature of the surrounding communities, and partly by the resources available to them. It is important to note that most of the districts adjacent to the zones (except for the district adjacent to the LGCA in the northern boundary which is home for Kenyan Maasai), are home for *Waarusha* and *Wambulu*. These are agro-pastoralists with a good background of cultivation, and that these districts are facing considerable pressure on their agricultural lands due to large numbers of human populations (Maro, 1994; Kimolo, 1995; MTNRE, 1996). However, the northern boundary of the LGCA is an international boundary between Kenya and Tanzania. The next ring is that of *Wameru*, an ethnic group renown for intensive cultivation resulting from severe land shortages (Maro, 1984; Kivelia, 1995). These observations suggest cultivation and land speculation to be the main motives for in-migration into the zones.

Information from informal discussions provides a broader understanding of other motives and processes of in-migration into the study area. Cases 1 – 4 (Box 7.2) present a range of motives and processes used by most of the in-migrants in the NCA. According to Box 7.2, the main motive for in-migration into the NCA is cultivation. Most of the in-migrants come from cultivator and agro-pastoral communities with land shortages, and on settling in the NCA, starts cultivation. Others are coming back to lands they cultivated prior to the ban on cultivation. A few are coming as labour migrants to the hosts' farms, but eventually start their own cultivation.

Processes of in-migration into the NCA involved liaison with residents, and disguising based on services and trade in the area. They use the routes that are not adequately controlled by the NCAA. Sometimes they use the gates that are controlled, provided they can bargain for permission. In general, the process suggests that there are weaknesses in effecting tight control over in-migration in the area, and that some residents contribute to this weakness.

Box 7.2: Motives and processes of in-migration into the NCA.

Case No.1: Age: 40's Sex: Male Education level: 1 Ethnicity: Mbulu.

- Migrated to NCA in 1994; initially encouraged and hosted by another Mbulu migrant who came to NCA a year earlier.
- Route: Through Olpiro, a sub-village of Endulen in the southern border of NCA. The plan was to disguise as if he was going to the hospital in Endulen. (The hospital also attends people from neighbouring villages outside NCA).
- Current host: A resident Maasai, for whom he works as a labourer. He stays in the farm full-time.
- Cultivates 1.0 acres (adjacent to the employer's farm) for his own use, and intends to increase every year. Goal is to own livestock and bring his family in the NCA if cultivation will not be banned again.
- Has no land for cultivation at place of origin. Used to borrow small patches which could not meet their needs.

Case No. 2: Age: 32 Sex: Female Education level: 3 Ethnic group: Meru

- Migrated into NCA in 1988; hosted by her father's other wife in NCA. (Father had 3 wives, two in Meru and one in the NCA). Currently married to a Maasai husband.
- Route: Through Loduare gate, permitted on grounds that the father's wife in the NCA was her mother. (Biological mother resides in Meru).
- Terminated secondary education because of social problems; ran away from Meru because there was too much to do and no land for her own production.
- Currently a housewife, doing petty business and cultivation.
- She obtained land through her husband (a resident).
- She says, "I can't sit idle looking at these fertile soils while I know how to work the soils".

Case No. 3. Age 44 Sex Male Education level: 3 Ethnic group: Mwarusha

- Migrated into NCA in 1993 and the rest of the family followed the next year.
- Route: Footpaths through Engaruka, into Kapenjiro area, then to the present location. (No control in these footpaths).
- Initial host: A resident family friend of the 1970's, prior to cultivation ban.
- Initial farms: Re-opened the farm that was once cultivated by relatives who were evicted during the ban on cultivation.
- Claims to have come back to their 'inheritance' farms because of inadequate land in place of origin.

Case No.4: Age: 40 Sex; Male; Education level 2; Ethnic group: Mwarusha.

- Started to live in NCA in 1994.
- Route: Loduare gate, with permission as a petty trader.
- Used to trade in hides and skins in the study area prior to the lift on cultivation ban. Initially living with friends (residents), and eventually started his own home in the boma of the friend. Later, acquired land for cultivation in the traditional way of Maasai, i.e. cultivating a small plot around the homestead (which has been increasing since then).
- Argument: Got tired of trading in hides and skins; decided to settle and own livestock; thought this was the place of choice because there is not enough land in area of origin.

Similar interviews in the LGCA pointed to cultivation and land speculation resulting from the policies in vogue. The responses were clear: We got information that land is available in these areas, requested to migrate to these places and were allocated land under normal procedures. Or, when we heard of barley cultivation by TBL, and that farms were being allocated to those who wanted to join in barley cultivation, we came to this place. The message was clear, and the motives were obvious. There was nothing of the nature of disguising comparable to that in the NCA.

7.5 Summary

The above analysis unveils some important relationships and processes between conservation/development policies and the increasing conversion of the rangelands into cultivation. There are considerable overlaps between cultivation and conservation and development policies to include: settlement schemes, conservation oriented practices and regulations, development projects, the changing control on access to land resources, and, in-migration.

In the first place, there is a considerable overlap in periods of settlement and that of first cultivation in olmarei, with inter-zonal variations that reflects the influence of the different policies in the two zones. In the NCA, the most important observation is that the lift on cultivation ban in 1992 was followed by 100% cultivation up-take (eligible households), followed by a significant increase in the proportion of households settling in the study sites thereafter. The 100% up-take suggest a high need for cultivation among the pastoralists, probably following a situation of stress in their livelihoods that may have developed gradually throughout the period of cultivation ban. Cultivation in the NCA is therefore linked with conservation policies and practices.

In the LGCA, the overlaps in settlement and cultivation reflect specific policy practices and development projects that attract cultivators (and cultivation) into the area. Overlaps in settlement and cultivation in Ololosokwan in 1976 – 1985 are associated with resettlement of in-migrants from Sakala and Loliondo township to Sero, a sub-village of Ololosokwan. Settlements and cultivation of the mid- 1980's, are associated with emerging markets alongside the introduction of large-scale cultivation projects and the development of Wasso into an administrative HQ for the district. Settlements and cultivation in Ng'arwa are responses to the district administration's efforts to promote cultivation.

In the second place, deliberate efforts to control or promote cultivation in the study area have had varied influences on the magnitude of rangeland conversion. In the NCA, restrictions on tools and size of farms keep household cultivation at low acreage. Conservation-oriented restrictions rather than ecological conditions limit those who wish to increase the size of their farms in this zone. On the contrary, the use of ploughs and tractors and the lack of restrictions on the size of farms in the LGCA allow for larger acreage per household. The majority of those who wish to increase cultivation are limited not by any authoritative restrictions but ecological factors. Yet, the average size of cultivated farms per olmarei in three sites in the LGCA was observed to surpass the traditional small-scale cultivation renowned among pastoralists of SEU (see chapter 5).

In the third place, cultivation is increasing with the introduction of some conservation and development projects. The barley project in the LGCA and other development-oriented projects in the NCA (e.g. tourist hotels, schools, etc.) have attracted cultivation of different crops, to include vegetables for the market. In the NCA however, cultivation associated with these projects is small in scale.

In the fourth place, the new (imposed) mechanisms of control over and access to land for cultivation may result in conflicting land uses between cultivation and wildlife-livestock. There is more danger of this nature in the LGCA if livestock-wildlife land-uses are not given priority when the district authorities allocate land for cultivation. In the NCA, the allocation of cultivation blocks is based on the needs of both conservation requirements and that of cultivation, therefore avoiding conflicting land-uses.

Lastly, policies on in-migration into the study area also influence the magnitude of rangelands conversion. In the LGCA where in-migration is allowed, there are more in-migrants converting the rangelands. In the NCA, only a few in-migrants have managed to penetrate.

Overall, the different policies subject the rangelands to different levels of conversion to croplands. On one hand, the lack of control over cultivation and in-migration in the LGCA has the potential for the development of conflicting land-uses in the area. On the other hand, the controls over cultivation and in-migration in the NCA may be advocated in that they are trying to harmonise land-use in the context of increasing subsistence needs for humans alongside conservation needs.

Logically, the above outcomes of conservation and development policies (and the associated increase in cultivation) may have far reaching implications regarding the future of pastoralism. This is vested on parallel developments and improvements in pastoral livelihoods (and therefore pastoralism, a land-use compatible with conservation needs) in the study area. The next chapter explores developments in pastoral livelihoods in the light of the influence of these policies and increasing cultivation.

CHAPTER 8

POLICY AND PASTORAL LIVELIHOODS

"Since the establishment of NCA in 1959, the Ngorongoro Maasai have been subject to various restrictions regarding their subsistence strategies, the most important of which has been the ban on cultivation from 1975". (McCabe et al, in Thompson, 1997:286).

8.1 Introduction

Chapter 7 has shown the varied contribution of conservation and development policies in the increasing cultivation in the study area. The influence of such policies on pastoralism and therefore pastoral livelihoods are examined in this chapter, in the light of rangeland buffer zones that were created to protect the core PAs, which therefore ought to be managed under conservation compatible land uses (pastoralism, wildlife and tourism).

As discussed in chapter two, pastoralists have, in the past, thrived in conjunction with agricultural societies, and their livelihoods have made sense only in a wider, less pastoral context[133]. The relationships included trade with cultivators (livestock exchange for grain and other items), seeking out allies and relations for support during times of dire food shortages resulting from epidemics of disease and drought. Own cultivation is also an important strategy particularly when livestock numbers are inadequate to meet food requirements, and also in herd building especially in situations of impoverishment. In some places, some impoverished pastoralists have adopted farming and become absorbed in the

[133] See for example Brockington, 1998; Sutton, 1993; Bonte and Galaty, 1991; Bentsen, 1979; Swift, 1976.

farmer communities[134]. If impoverishment and loss of pastoral livelihoods continues, thus giving way to increased cultivation, the objectives of creating the east African rangeland buffer zones may not be achieved.

It was shown in chapter 2 that land use policies-cum-practices that alienate the pastoralists from their pastoral territories and/or those interfering with their production systems and strategies may create conditions of stress on the pastoral economy, leading to loss of pastoral livelihoods[135]. In the same vein of argument, the different land use policies implemented in the study area since 1975 are assumed to have different impacts on the livelihoods of the pastoralists living in the NCA and LGCA. On one hand, there are controls on access to and management of the range resources in the NCA together with the changing policies on cultivation[136] (causing conditions of uncertainty regarding cultivation which, as McCabe (2004) puts it, 'is the first and most significant step in the process of livelihood diversification going on today among the pastoral Maasai of Northern Tanzania'). While conservationists may favour such policies, they (the policies) may limit livelihoods portfolios among the NCA pastoralists. On the other hand, the land use policies in the LGCA allow all sorts of development (including mechanized farming). These 'development oriented' policies are viewed as promoting diversification in pastoral livelihoods in the zone. However, they may at the same time, result into curtailed pasturelands, particularly the dry

[134] See Spear & Waller, 1993.
[135] See for example Brockington and Igoe, 1999; Brockington, 2000; Mac Cabe, 1997; Parkipuny, 1995.
[136] Initially, cultivation was allowed in the NCA on its establishment as a multiple land-use area. Cultivation was banned in 1975. The ban was lifted in 1992; reinstated by the Prime Minister of the URT on September 2001; lifted again by the President of the URT on October 2001.

season refuge areas. Also, they may bring into the rangelands land use practices and cultures that are not compatible with pastoralism and wildlife conservation. Yet, plausible conservation and development policies in these buffer zones ought to harmonise the livelihoods needs of the growing human population alongside those of wildlife and biodiversity conservation.

The chapter compares livelihoods between NCA and LGCA pastoral households, as a way of assessing the influence of the different conservation and development policies on pastoral livelihoods in these rangeland buffer zones. The chapter further assesses the implications of the increasing cultivation with regard to the future of pastoralism and wildlife conservation.

The comparisons are made in the light of sustainable livelihoods framework, which takes the form of assets-access-activities (Ellis, 1999). In this context, livestock, which dominates pastoral livelihoods, is seen as the basic financial capital (alongside other forms and sources of financial capital) whereas the range resources are the natural capital. The different conservation and development policies operating in the two zones are assumed to mediate access to the rangeland resources for pastoralism and also for their conversion to cultivation. The comparison is therefore guided by the following assumptions:

1. Pastoral livelihoods in the NCA and LGCA are deteriorating under conditions of policies associated with:
   (a) Declining livestock economy where a large proportion of pastoral households have herds too small to meet their subsistence needs.

(b) Situations that do not fully support the pastoral production system (e.g. situations of inadequate and intermittent supply of grain; disproportional prices between livestock and cultivated crop; lack of markets for livestock and livestock products, inadequate control of livestock diseases, etc.)

2. The importance of cultivation as a livelihood strategy is increasing with declining livestock numbers among pastoralists of both NCA and LGCA.
3. The increasing cultivation in the rangelands is influencing changes in peoples' perceptions and practices in land tenure that may translate into private ownership of land within these otherwise collectively owned rangelands. The changes may have adverse effects to the future of both pastoralism and wildlife conservation.

Specifically, comparisons will focus on:

1. Current situation of the livestock economy and the influence of conservation and development policy on different aspects of livestock development.
2. Cultivation and other non-pastoral livelihoods activities and their contribution to the pastoral economy.
3. The changing perceptions in land tenure and associated land-use conflicts that arise with increasing cultivation.

8.2 Data and Methods

The chapter is based on data from 159 pastoral households residing in the study area (76 in the NCA and 83 in the LGCA)[137]. Four levels of data are used: the two-round household survey data from the 159 pastoral households, market survey data, intensive multi-round data from 30 sub-households (within the 159 pastoral households), and, qualitative data from KI discussions and meetings. These are used alongside archival data from district files, and analyses resulting are presented in tables and other qualitative forms and compared between the two zones. As it was done in chapter 7, data from Wasso, Sakala and Ng'arwa (LGCA centre) are compared with that of Ololosokwan and Arash (LGCA periphery) where necessary.

8.3 Livestock Economy

It was shown in chapter 2 that livestock remains at the centre of Tanzanian pastoralists' livelihood strategies, and for this reason, a household's livestock herd ought to be large enough to meet their different livelihoods needs, including subsistence[138]. In the context of exchange oriented pastoral economy, as is the case for the study area, herd size and growth dynamics should allow for sustainable off-takes[139].

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[137]The 206 sample households constituted a total of 159 households that identified themselves as pastoralists (76 in the NCA and 83 in the LGCA).

[138] Harris, quoted in NEMP (1989), estimated that an individual required an average of 5.5 cattle, 9.5 goats and 10 sheep to survive. This is an equivalent of 8.7 LE/RA. Jewell, quoted in McCabe (1997), estimated a total of 44 cattle and 100 small stocks for a household of 8 people. This is an equivalent of 7.5 LE/RA.

[139] McCabe (1997) estimated an average off-take of 0.46 LE/capita required to purchase grain in the NCA. According to this study, 0.54 LE/RA would be required (calculations based on McCabe's 131Kg/RA/year with the assumption of dietary intake of 65% grain, but up-dated to 1999 market prices of 250 Tanzanian shillings (TShs.) per Kg of grain and TShs. 60590 per LE).

8.3.1 Size of livestock herds

In this study, the overall ratios of livestock to human populations (Table 8.1) were found to be below the estimated requirements discussed above. The overall mean was 4.28 LE/RA, with NCA registering a significantly lower mean than that of LGCA (2.98 LE/RA and 5.47 LE/RA respectively, $p < 0.001$). Within LGCA, significant difference existed between sites surrounding the Loliondo administrative centre and those in the periphery (4.00 LE/RA and 7.70 LE/RA respectively; $p < 0.001$).

Table 8.1: Subsistence indices among pastoral households (N = 159)

Indices	Overall (N = 159)	NCA (N = 76)	LGCA (N = 83)		LGCA Centre (N = 50)	LGCA Periphery (N = 33)
LE per household Std. Deviation	38.75 54.7156	24.76 34.3770	51.55 65.8812		28.11 31.8633	87.078 86.0653
RA per household Std. Deviation	7.5 4.782	7.2 4.737	7.7 4.840		6.3 3.526	9.9 5.725
LE per RA Std. Deviation	4.28 3.7455	2.98 2.5593	5.47 4.2465		4.00 3.6399	7.70 4.17215

The overall size of livestock herds (Table 8.1) do not allow for off-takes of 0.54 LE/RA[140] required to meet the minimum per capita grain requirements on a sustainable basis. Only the sample households in the LGCA periphery have livestock-human ratios (7.7 LE/RA) that are within the estimated requirements. The rest have LE/RA ranging between 3.0 and 5.5. Yet, pastoralists in the study area have to sell livestock to cater not only for grain requirements but also other livelihoods needs like medication for humans and livestock, development levy, and, education to mention but a few.

[140] See footnote 139

8.3.2 Livestock distribution

The problem of livestock numbers that are too small to meet subsistence needs is further compounded by its highly skewed distribution among the sample households. Table 8.2 shows that only 15.1% of the sample households in the study area had more than 8.0 LE per RA. Another 25.8% had between 4.0 and 8.0 LE per RA, and the remaining majority (59.1%) owned less than 4.0 LE per RA.

Table 8.2. Distribution of livestock wealth measured by LE/RA

Livestock wealth		Overall	NCA	LGCA	LGCA Centre	LGCA Periphery
0.00 – <4 LE/RA	Count	94	60	34	27	7
	% within Zone	59.1%	78.9%	41.0%	54.0%	21.2%
4.00 – <8 LE/RA	Count	41	10	31	17	14
	% within Zone	25.8%	13.2%	37.3%	34.0%	42.4%
8.00+ LE/RA	Count	24	6	18	6	12
	% within Zone	15.1%	7.9%	21.7%	12.0%	36.4%
Total	Count	159	76	83	50	33
	% within Zone	100.0%	100.0%	100.0%	100.0%	100.0%
Chi-square test results		Chi-sq. = 23.689; df = 3 P < 0.001			Chi-sq. = 11.028; df = 3; P < 0.02	

Comparing the two zones, the situation was precarious in the NCA where only 7.90% of the sample households had over 8.0 LE/RA, 13.2% between 4.0 and 8.0 LE/RA and the remaining majority (78.9%) owned less than 4.0 LE/RA. The LGCA was slightly better, as 21.7% of the sample households owned over 8.0 LE/RA, 37.3% owned between 4.0 and 8.0 LE/RA, and the remaining 41.0% owned less than 4.0 LE/RA. The difference in livestock distribution between NCA and LGCA was statistically significant (Chi-square = 23.689; $p < 0.001$; df = 3).

The distribution in the LGCA was also highly skewed, with the LGCA periphery having better conditions than the LGCA centre. About 36.4% of the sample households in the LGCA periphery owned over 8.0 LE/RA, and only 21.2% had less than 4.0 LE/RA. In the contrary, only 12.0% of the sample households in the LGCA centre owned over 8.0 LE/RA, and the majority (54%) owned less than 4.0 LE/RA. The difference in livestock distribution between LGCA centre and LGCA periphery was also statistically significant (Chi-square = 11.028; $p < 0.02$; df = 3).

Generally, the livestock economy in the study area has deteriorated significantly while human population has increased dramatically since 1975 (See Table 3.1, Chapter 3). Household herds in the LGCA centre and in the NCA are too small to meet subsistence needs of the pastoralists although the condition of the LGCA centre is slightly better than that of the NCA. However, sample households in the LGCA periphery showed LE/RA values that may meet subsistence requirements.

8.4 Constraints in the development of pastoralism

It was shown in chapter 1 that suitable land uses in the east African rangeland buffer zones are pastoralism and wildlife conservation. Implicitly, both conservation and development policies operating in the area are envisaged to promote pastoralism as the main economic activity and a livelihood strategy. Otherwise, the rangelands will continue to be converted to croplands as pastoral livelihoods continue to deteriorate. This section explores policy aspects that may have contributed to the observed deterioration in livestock economy and therefore pastoral livelihoods. It analyses the availability of grain, the influence of markets, and general problems hindering livestock development in light of conservation and development policies operating in the study area.

8.4.1 Availability of grain in the framework of traditional pastoral systems.

As discussed in chapter 2, situations of food shortage and hunger are frequent among East African pastoral communities. In the framework of traditional pastoralism[141], strategies of ensuring food security included small-scale cultivation, making allies with cultivator communities, friends and kinsmen for livestock-grain exchange, trade, gifts, etc. Food aid from government and non-government institutions is a recent phenomenon. With the increasing demand of grain, these or alternative strategies need to be functional. The ban on cultivation and restrictions on in-migration in the NCA, and the general trend toward market economy in many parts of Tanzania and the world, are assumed to affect availability of grain in the study area, particularly the NCA. Table 8.3 portrays the contribution of current strategies to the present-day grain requirements in the study area, and the relative importance of each strategy.

The results suggest that the traditional livelihoods support system and the general economic relations between pastoralists and cultivator communities are no longer functional. The observation of only 13% of the sample households receiving grain (in the form of gifts or loans), and, 15% and 13% exchanging grain for cattle and small stock respectively, are too small to substantiate a functioning

[141] See Waller, 1989; Kjekshus, 1977.

pastoralists - cultivators economic and livelihoods support system. That the majority of households depended more on sales of livestock and other sources to purchase grain, or on food aid provide further evidence of a non-functional pastoralists – cultivators relationship.

Table 8.3 Sources of household grain in the pastoral households[142]

Sources of grain received, 1999	Overall (N = 159)	NCA (N = 76)	LGCA (N = 83)	Comments: Quantity; terms
Gifts/loans from friends/kinsmen	20 (13%)	7 (9%)	13 (16%)	• 36kg – 126kg per h/hold gifts; 90kg – 180kg long term loans
Exchange with cattle	24 (15%)	6 (8%)	18 (22%)	• 90 – 270kg;1 – 2 steer/heifer • Common within LGCA
Exchange with small stock	20 (13%)	12 (16%)	8 (10%)	• 18 – 180 kg; 1 – 7 s/stock • Important in NCA
Market sales of cattle	67 (42%)	36 (47%)	31 (37%)	• 270 – 720kg; 1 – 3 bulls • % proceeds for other needs
Other sources (e.g. savings)	56 (35%)	15 (20%)	41 (49%)	N/A.
Food aid from diff. institutions	60 (38%)	27 (36%)	33 (40%)	• 18 - 54kg depending on size of family

Note: The container used to measure quantities of grain is the "debe," approximately 18kg.

That LGCA has 16% and 22% of the households obtaining grain from gifts/loans and exchange with cattle respectively, and 49% from other sources imply a slightly better condition compared to the NCA. Here, only 9% and 8% of the households obtained grain from gifts/loans and exchange with cattle respectively, and only 20% from other sources. Also, NCA had a slightly larger proportion of households exchanging grain with small stock (16%) compared to LGCA (10%), a typical feature of stress in the livestock economy.

[142] Excludes grain obtained from own cultivation.

In addition to the observation that only a small proportion of the sample households obtained grain through different support mechanisms, the amount received as gifts and loans was rather too small to support the pastoral system under conditions of food shortage. The gifts ranged from two to seven 18kg 'debes' per household whereas the loans ranged from five to ten 18kg 'debes'. Similarly, food aid was very infrequent, and the quantities received were too small to take them through the wet season. Plate 8.1 shows people in Loliondo township queuing desperately for food aid. They come from all the sites surrounding the township.

Plate 8.1 People queuing for food aid in Loliondo township, Feb. 1999

Discussions pointed to several issues that were contributing to declines in the livestock-grain exchange system: In the NCA, eviction of cultivators following the ban on cultivation, compounded by control over in-migration and the associated restrictions on visitors was seen as weakening the pastoralists – cultivator's relationships. In the LGCA, relationships were maintained between cultivators in Loliondo and the surrounding sites (especially Sakala). However, tribal conflicts between Maasai pastoralists and Batemi cultivators in the neighbouring Sale division had considerably weakened the wider pastoralists – cultivator's relationships[1].

8.4.2 Markets support in the pastoral system

The researcher and three assistants conducted market surveys in three open markets operating in the study area. In the LGCA, the market (located at Wasso) operated on a weekly basis. In the NCA, each of the two markets (Nainokanoka and Endulen) operated twice a month. Each of the three markets was visited two to three times in each season. In each visit observations were made on the availability of cultivated and livestock products and their related inputs, as well as their prices. Records involved information on whether the observed items were sufficiently available throughout the market session or not. Prices were recorded as observed, and in cases of significant variations, (as was the case with livestock prices) a range of individual observations covering the different types of livestock by age and sex were recorded, and averages worked out later. The data collected in this way was then summarised and compared between the two zones.

[1] Pers. Comm.; Marosek,. (Ward Executive Officer, Loliondo Division); Ole-Kukuyet, The chairman of Ng'arwa village

The main purpose of the market surveys was to obtain a general assessment of the contribution of markets in supporting livestock economy, bearing in mind the seasonal fluctuations in availability and prices of both grain and livestock. The main assumption is that conservation and development strategies (e.g. controls on entry to the NCA, investment in transport infrastructure, control on prices etc.) may influence both availability and prices of different products, thus affecting the pastoral economy. Table 8.4 presents a snapshot situation of availability and prices of different goods/products that may have a direct influence on the pastoral economy and cultivation.

Table 8.4. Availability index and prices of goods/products in different markets

Name of Market	Goods/products observed	Wet season		Dry season	
		Index	Unit price	Index	Unit price
Endulen and Nainokanoka NCA)	Cattle	1	43440/=	1	48760/=
	Small stock	2	6890/=	2	7140/=
	Hides/skins	2	330/=	2	380/=
	Milk & milk products	2	200/=	3	N/A.
	Maize	2	4000/=	2	1400/=
	Maize flour	2	300/=	2	250/=
	Beans	3	N/A	2	250/=
	Inputs for livestock	3	N/A	3	N/A
	Tools for cultivation	1	1500/=	2	1500/=
	Inputs for cultivated crops	3	N/A	3	N/A
Wasso (LGCA)	Cattle	1	55400/=	1	57600/=
	Small stock	1	7200/=	1	8550/=
	Hides/skins	1	750/=	1	700/=
	Milk & milk products	1	200/=	1	200/=
	Maize	2	4250/=	1	1500/=
	Maize flour	1	350/=	2	250/=
	Beans	2	400/=	2	200/=
	Inputs for livestock	1	Varied	1	Varied
	Tools for cultivation	1	1700/=	1	1700/=
	Inputs for cultivated crops	3	N/A	3	N/A

Index of Availability:

1. Good, available almost throughout the market session;
2. Moderate, available in small quantities, not lasting the whole market session.
3. Not available/not seen in the market

The results show important variations in the availability of both products of and inputs for livestock and cultivation between the two zones. Except for cattle which is generally available at all seasons, the NCA exhibited moderate to non-availability of small stock and other livestock related products, grain and related products, and also production inputs for both livestock and cultivation. However, cultivation tools (hoes) were adequately available. In the contrary, all indices related to availability of livestock and livestock products were good for all seasons in the LGCA. The indices for grain and its related products ranged from good to moderate. Index for inputs and tools for production was good except for inputs for cultivated crop. Availability of milk in the LGCA was linked with markets in Loliondo township. Such markets did not exist in the NCA. The upper hand in availability of both livestock and cultivation goods/products in the LGCA compared to the NCA may be a reflection of the observed division of the zone into two land use units and the higher levels of cultivation in the area, which, in turn, encourage trade.

Livestock prices were generally low compared to prices in markets outside the study area[144]. The prices were lower in the NCA compared to the LGCA, and this was associated with illegal cross-border livestock trade, which was easier for LGCA pastoralists. In the LGCA, livestock prices range from TShs. 28000 for immature heifers (approx. 2 year olds) to TShs. 95000 for a mature bull[145], and from 5000 to 16500 for small stock. The average price was 56,000 per cattle head. In the NCA, the prices ranged from 25000/= (immature heifers and steers) to 80000/= for a mature bull, average price was 47600 per cattle head. No significant variation with season for cattle in both zones, probably because livestock conditions remained fairly good for the entire period of the study. (El-nino rains of 1997/98 resulted in a shortened dry season. Also, the long rains in 1999, though intermittent, were prolonged). For small stock, prices in Wasso (and to some extent the other markets) rose sharply in the period of August 1999 because of a temporary market in Kenya associated with an outbreak of livestock disease in northern Kenya.

In both zones, maize was selling at a price of TShs 1500 per 'debe' (equivalent to 16 - 18kg), i.e. TShs 7500 per 90kg bag at the time of harvest. The price shoots to TShs 5000 per 'debe', i.e. TShs 25000 per 90kg bag during the rainy season. Where there are no monthly markets grain prices were higher, up to 28000 per 90Kg bag. These seasonal fluctuations in prices for grain were at the

[144] Market prices in markets outside the study area ranged from 40000/= to 120000/= in Arusha, and from 85000/= to 200000/= in Dar es Salaam (URT, 1999). (Only mature livestock are sold in Dar es salaam)

[145] According to informants who were involved in cross-border livestock trade, the same bull would fetch around KShs. 16000, equivalent to TShs 160000 (£160) if sold in Narok, Kenya.

disadvantage of the pastoralists. Kjaerby's (1979) estimate of 5 livestock units per capita (for exchange oriented economy) was based on an assumption that 1 livestock unit would buy 5 bags (450Kg) of grain. Simple calculations from the above observations suggest that 1 LE would buy only 2 bags during the rainy season.

In short, the market situation does not fully support livestock economy. In addition to high grain prices particularly in the rainy season (when pastoralists have no grain), the supply of grain from outside the study area was inadequate, probably because of the poor roads. Moreover, NCA was in a precarious situation in that there existed no cultivation niches (as opposed to LGCA), and movement into the zone was regulated. Yet, the removal of cultivators from the NCA and the subsequent ban on cultivation was to go hand in hand with the supply of grain on a subsidized price (by the NCAA) in the study area[146]. However, there were no observations neither reports of grain supplies from the NCAA or the district administration during the period of this study. Food aid reported above (Table 8.3) came from institutions like WFP and CARITAS.

8.4.3 Livestock problems

To manage the buffer zones under pastoralism and wildlife conservation in the light of increasing human population also demand strategies and policies that promote growth in livestock economy. This section examines persistent livestock

[146] See MTNRE, 1996; TWCM, 1997; Shivji and Kapinga, 1997.

problems and the efforts (from the NCAA and the district administration) to alleviate them.

During questionnaire interviews, respondents were asked to name one most important problem they considered to be the cause of the declining livestock numbers. Table 8.5 presents an array of the identified problems.

Table 8.5: Perceived major livestock problems in the study area

Main Livestock Problem		NCA	LGCA	TOTAL
Diseases	Count	35	29	64
	% within Zone	46.1%	34.9%	40.3%
Declining pasturelands	Count	15	28	43
	% within Zone	19.7%	33.7%	27.0%
Subsistence use	Count	25	6	31
	% within Zone	32.9%	7.2%	19.5%
Drought	Count	0	11	11
	% within Zone	0.0%	13.3%	6.9%
Rustling	Count	1	9	10
	% within Zone	1.3%	10.8%	6.3%
Total	Count	76	83	159
	% within Zone	100.0%	100.0%	100.0%

Accordingly, the most important problems were livestock diseases (identified by 40.3% of the respondents), declining pasturelands (27.0%) and subsistence use (19.5%). Only a few respondents identified problems of drought and cattle rustling (6.9% and 6.3% respectively).

Problems of diseases are not uncommon in the east African rangelands in general, and in the study area in particular[147]. NIRDEP, (1998) observed that diseases were killing about 40% of the calves in the first year, and up to 79% in the second year. This threatening situation is however, exacerbated by poor availability of

[147] See Homewood and Rogers, (1991) for a list of common livestock diseases in the NCA.

veterinary services, particularly acaricides and other drugs for livestock diseases that are common in the area. Physical inspection of some of the dipping facilities by the researcher, and also KI discussions in the different study sites indicated that several of the facilities were not working, some because of lack of acaricides, and others because of their devastating conditions.

Observations suggested that the lack of veterinary services was affecting poorer households more because some of the wealthy households could manage to purchase the acaricides and the necessary equipment and spray their livestock at home (see Plate 8.2). The situation was better in the LGCA where the researcher observed four different sessions of spraying activities in three households in Ng'arwa and Wasso, and only one in Oloirobi, NCA.

Plate 8.2: Spraying livestock at home. Centralized dipping facilities are lacking.

Declining pasturelands is a problem acknowledged in many other parts of the east African rangelands, and the main causes include the delineation of the rangelands as protected areas and their conversion into croplands[148]. The curtailed pasturelands, and particularly those coming under non-Maasai large-scale cultivation has been the main source of land use conflicts in the rangelands, and a threat to the future of pastoralism and wildlife conservation as land use types that are compatible with the ecological conditions of these rangelands.

Decline in livestock numbers resulting from subsistence use is an indication of a failing livestock economy, usually associated with inadequate supply of grain and the consequent unequal terms of trade (between livestock and grain). Under such situations, pastoralists diversify their livelihoods out of necessity rather than opportunities. They commonly turn to cultivation to meet their subsistence needs and re-build their herds. In the course of such diversifications, other pastoralists may become cultivators[149].

The livestock problems identified above suggest a trend of continuing decline in the livestock economy in the both zones. However, the factors identified as leading to the dwindling of livestock numbers per household varied in order of importance between NCA and LGCA.

[148] See for example, Parkipuny, 1988; 1996; Brockington & Homewood, 1999.
[149] Examples abound of pastoralists in the East African rangelands who have settled as cultivators after incidents of significant decimation of their livestock. See for example, Waller, 1989.

While there was a consensus in the ranking of diseases and the problem of cattle rustling, there were differences in the order of importance in all other identified problems. In the NCA, the second in order of importance was the problem of subsistence use of livestock whereas in the LGCA this was ranked fifth, hence considered less important in this zone. Declining pasturelands was ranked third in the NCA, but second in the LGCA. Drought, which was ranked third in the LGCA, was ranked fifth in the NCA.

Except for the ranking of drought (an ecological aspect which varies between some of the LGCA sites), KI and group discussions linked the observed variations (in the order of importance of the identified livestock problems) between NCA and LGCA with conservation and development policies that operate differently in these zones. This section analyses the influence of these policies on three main problems: diseases, declining pasturelands and subsistence use of livestock.

8.4.3.1 Livestock Diseases

Development and conservation policies are viewed as exacerbating the problem of livestock diseases in the area in different ways. Firstly, KI discussions in five study sites (Endulen, Oloirobi and Nainokanoka in the NCA, and Ololosokwan and Arash in the LGCA) blamed the increase of diseases on the villagisation policy of 1976. Accordingly, the policy huddled pastoralists together in permanent settlements that are rather compact (as opposed to the traditional dispersed settlements). The resultant clustering of livestock is argued to facilitate and accelerate the spread of contagious diseases, particularly in the absence of adequate and effective veterinary services. Villagisation was however not linked with livestock diseases in the remaining sites (Sakala, Wasso and Ng'arwa). This is not unexpected for Sakala and Wasso, renowned as long-time established cultivator niches. Ng'arwa, which is progressively developing into a pastoral-cultivator niche, may not link villagisation with increasing livestock diseases because the history of settlement in the site shows that pioneers settled voluntarily after villagisation for the purpose of cultivation, following different events that had caused them devastating livestock losses.

Secondly, there are biases in the overall development policies, manifest in the non-implementation of livestock development plans. This is also acknowledged, in a way, by the district administrative circles as they show plausible livestock development plans that are not implemented.[150] NIRDEP (1998) puts the blame on lack of funds for both development plans that ought to be funded internally (i.e. development plans that have been accepted and passed by the District Finance and Planning Committee for implementation) and those whose source of fund is the central government. The implication is that the funds generated from different sources in these rangeland buffer zones (including tourism related activities) and those from the central government are not sufficiently invested in the development of pastoralism (and therefore the pastoralists).

[150] District file No. A/FAM/AR/Loliondo recurrently acknowledged problems of food insecurity associated with declining livestock, and set strategies to alleviate them. The first strategy has always been to improve livestock production. However, there were no reports on e.g. dips or water dams that had been rehabilitated or built to this effect, but explanation of insufficient funds as reasons to why the plans had not been accomplished.

In the third place, there are observations of an increasing rate of diseases associated with conservation policies in the NCA. The increase of wildebeest numbers[151] and their encroachment into the western plains (areas formerly occupied by pastoralists before villagisation), together with the ban on the use of fire in the traditional rangeland management practices (to control ticks and other pests related diseases), are all viewed as causes of the predominance of livestock diseases in the NCA. There are no such complaints in the LGCA.

8.4.3.2 Declining Pasturelands

Declining pasturelands are also associated with development and conservation policies. In the NCA, declining pasturelands were associated with conservation regulations on the utilisation of various range resources, particularly the crater and the highlands pasturelands.[152]and also the encroachment of wildebeest into the western lowlands.[153] In the LGCA, KI discussions in three sites (Sakala, Wasso and Ololosokwan) associated the declines in pasturelands with development policies that encourage the conversion of large tracts of pasturelands to croplands in a context of turning the rangelands into a granary[154]. The TBL farm in Soitsambu and the then TCP farm in Ololosokwan were repeatedly mentioned as living examples in several KI discussions. Moreover, resentments against alienation of land for non-pastoral uses (allocated to people from outside the pastoral community and through politically imposed rather than traditional

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[151] Mwalyosi, (1999) reports of significant growth in wildebeest numbers in the area in the last decade

[152] Livestock are allowed in the crater and the highlands only with special permission from the NCAA.

[153] The wildebeest delineate the lowlands from livestock pasturelands because they carry the MCF (which kills livestock) with them.

[154] See chapter three.

leadership) seemed to be the main explanation of the high ranking of the problem of declining pasturelands in the LGCA. In Ololosokwan, villagisation policy was associated with declining pasturelands in light of the resulting land tenure regimes. Villagisation was equated with converting the then communally owned rangelands into open access resources, thus justifying their allocation to incoming investors as idle lands.

8.4.3.3 Subsistence use

The ban on subsistence cultivation in the NCA from 1975, and the conditions of the lift on the ban in 1995 are all associated with the high ranking of subsistence use of livestock in the NCA as a cause of the decline in livestock numbers. The main argument is that the NCA pastoralists were subjected to conditions of inadequate supply of grain, forcing them to rely heavily on their livestock, and under conditions of unfavourable livestock-grain prices. This is not the case in the LGCA where there are no restrictions on cultivation, and where there were more reliable sources of grain from the existing cultivation niches (Sakala, Wasso, Sero sub-village and the Sale division occupied by Batemi cultivators).

8.4.4 Livestock and human population growth

Existing empirical studies[155] partly link the declining ratios of LE/RA with the problem of a rapidly growing human population in these rangelands[156] against non-growing livestock numbers compounded by the culture of livestock

[155] See TWCM, 1997; Mac Cabe, 1997; MTNRE, 1996
[156] Human population growth rate in the study area surpasses the national growth rate by far. See chapter 3.

ownership, which is mainly through inheritance (and access through kinship)[157]. Accordingly, the human population has more than doubled in the past 25 years, while there has been no significant increase in livestock numbers[158]. This makes the pastoralists of today to be poorer than those of the 1970's. The increasing poverty is more pronounced at household level because of the skewed distribution, further compounded by the predominant mode of livestock acquisition.

In addition to the mismatch in growth between human and livestock populations, it has been shown that conservation and development policies do not adequately support livestock development in the study area. While the current livestock herds are too small to independently and sustainably support pastoral livelihoods, the traditional mechanism of accessing grain in a pastoral framework is no longer functional, and conservation policies are among the culprits of this disfunction. Also, the markets do not fully support the pastoral production system. Moreover, a number of livestock problems like diseases and declining pasturelands, and, subsistence use (of herds that are already small) contribute to the decimation of the livestock in the area.

These problems are a potential driving force towards the collapse of the pastoral economy and aggravated poverty. Unfortunately, such problems are more pronounced in the NCA where conservation policies do limit not only access to crucial rangeland resources for the development of livestock (critical pasture areas

[157] See Runyoro, 1996; Potkanski, 1995; Homewood & Rogers, 1991 for property rights/access in the area.
[158] See NIRDEP, (1998), ICS, (1997) and Appendix 8.1 for trends in human and livestock populations in the area.

and salt licks) but also other livelihood diversification options. This is not so much the case with LGCA centre where, despite the livestock herds that are generally comparable with those of the NCA, cultivation and other livelihoods activities have no restrictions that are related with conservation and development policies. However, the overall observation is that the two zones are subjected to conditions of increasing poverty in a context of a growing human population without a corresponding growth in the livestock economy.

8.5 Livelihoods Diversification

With the gradually dwindling livestock numbers and increasing poverty, households are forced to take up other livelihood strategies intended to reduce the obvious subsistence gap, support the threatened pastoral system, and, pursue prosperity. On one hand, the inadequate milk supplies from the few livestock is assumed to trigger changes in the types and patterns of foods consumed. On the other hand, households are envisaged to engage in other livelihood portfolios so as to cater for food and other subsistence needs. This section examines and compares changes in food patterns and the different livelihood strategies adopted by pastoralists in the two zones. It further examines the contribution of cultivation in the pastoral livelihoods and economy in general.

8.5.1 Increasing importance of cultivated crops in the pastoral diet

Evidence of increasing importance of non-pastoral foods in daily meals was obtained from observations on frequency of meals eaten in households. Information on the types of foods in different meals was recorded through participatory observations and dietary recalls in a total of 30 sub-households for a total of 8 – 10 days in each season (total of 17 – 20 days per sub-household). The researcher recorded frequencies of meals (by type of foods constituting those meals) as per observation and recalls. The foods were classified as meals of only pastoral products (milk or meat only), meals of a mixture of pastoral and cultivated foods (e.g. tea with milk, porridge with milk, stiff porridge eaten with milk or meat as relish), and, meals of cultivated crop only (i.e. eaten without meat or milk).

Between two and four meals per day were recorded in different days and sub-households. Table 8.6 presents the results of 826 observations of meals from 30 pastoral sub-households, pooled to cover both the pre-harvest and post-harvest periods.

Table 8.6: Mean frequency of meals by type of food (multi-round data)

Type of meal	NCA (N = 408)	LGCA (N = 418)	Overall (N = 826)
Pastoral products only (%)	9.17	7.45	8.31
Mixed: pastoral & cultivated foods (%)	70.15	81.79	75.97
Cultivated crop only (%)	20.68	10.76	15.72
Overall (%)	100.00	100.00	100.00

N = Total number of meals observed in 15 sub-households for 17 - 20 days per sub-household.

Accordingly, meals of mixed pastoral and cultivated products dominate the observations (76%). Non-pastoral products dominate a further 16% of the meal frequencies, and only 8% of the observations were pastoral foods only, i.e. milk or meat or both. The pattern is indicative of the overall importance of cultivated crop in the pastoralists' food requirements.

The high frequency of meals of mixed products and the non-pastoral foods translates to increased grain in the diet because the main constituent of these meals was grain. The dominant grain was maize. Maize meal was prepared in the form of thick porridge eaten with milk (as relish) or other types of relish such as meat, beans, and vegetable. Occasionally the stiff porridge was eaten without any relish (one observation). Alternatively, maize meal was prepared as a light porridge with water and milk, commonly sour milk. This second option was preferred in times of food shortage because a household can survive on small quantities of maize meal and milk. Although people will tend to be generally under-fed, it is a strategy which takes them through seasons of food shortage, particularly at the beginning of the short rains when grain is in short supply and milk yields at the lowest.

Table 8.7 presents the average grain intake per RA by zone, based on estimates of total grain consumed per household during the 8 - 10 days intensive survey.

Table 8.7 Quantity of grain consumed per RA/day

Zone	N	Mean (Kg)	Std. Deviation
NCA	15	0.3554	0.11018
LGCA	15	0.4304	0.16912
Overall	30	0.3929	0.14534

N = Total number of sub-households in the multi-round sub-sample.

The means are slightly lower than 0.5kg per person per day estimates found in the district files[159], but higher than the 306g observed among NCA Maasai in 1981

[159] According to the Ngorongoro District Agricultural Officer the estimates from the district files do not result from research. They are figures used for planning purposes (including strategies to solicit food aid).

(Homewood and Rodgers, 1991:221), an indication that the amount of grain consumed per individual and therefore overall grain requirements has increased.

The above observation links the increase in grain consumption with the declining capacity of the livestock economy to meet food requirements in the study area. The increased grain requirements together with the failure of the traditional means of accessing grain in the study area are envisaged to compel the pastoralists to adopt other livelihood activities, including cultivation.

8.5.2 Livelihood activities in the NCA and LGCA

Table 8.8 presents a range of livelihood activities (other than pastoralism) pursued in the households, either by the entire household or by at least one of the members of the household for the purpose of contributing to household subsistence needs.

Table 8.8 Livelihood activities in the study area (N = 159)

Activity	OVERALL (N = 159)	NCA (N = 76)	LGCA (N = 83)	LGCA Centre (N = 50)	LGCA Periphery (N = 33)
Cultivation	91.2%	100.0%	83.1%	98.0%	60.6%
Wage employment (civil)	3.1%	2.6%	3.6%	4.0%	3.0%
Petty business	3.8%	2.6%	4.8%	8.0%	0.0%
Trading in livestock	4.4%	1.3%	7.2%	8.0%	6.1%
Trading in grain	1.3%	0.0%	2.4%	4.0%	0.0%
Selling forest products	2.5%	1.3%	3.6%	6.0%	0.0%
Tourist related activities	3.8%	3.9%	3.6%	2.0%	6.1%
Paid causal labour	5.0%	1.3%	7.2%	10%	13.0%
None/Not stated	72.3%	77.6%	67.5%	62.0%	81.8%

According to Table 8.8, all of the activities are those made possible by the economic and natural resources base of the area. The only exception is wage employment in the civil service which, being a preferred activity but limited by accompanying pre-conditions (education, professional skills, etc.), may not quite correctly reflect a livelihood strategy adopted in the context of this discussion. Activities like cultivation, harvesting and selling of forest products (e.g. fuel wood, building poles, honey, etc.), and trading in livestock and grain, petty trade in other consumer goods and tourist related activities (trade in beadworks, traditional dances and other economic activities in cultural bomas) are all made possible by the natural resources endowment and the economic systems of the study area (see chapter 3). Plates 8.3 and 8.4 show people engaged in beadworks and selling fuel wood respectively.

Plate 8.3: Maasai women doing beadworks - sold to tourists and other customers

Plate 8.4: A Maasai woman with a load of firewood trying to find buyers in Loliondo township

Considering the relative importance of these activities, cultivation stands out as the single most important activity. It has been adopted by 91.2% of the 159 pastoral households in the sample (100% and 83.1% in the NCA and LGCA respectively; 98.0% and 60.6% in the LGCA centre and LGCA periphery respectively). Other activities had been adopted by only a small fraction of the sample households (between 1.3% and 5.0%),[160] and these were adopted in conjunction with cultivation. Moreover, cultivation was reported as the main source of household income in 20.8% of the 159 pastoral households (Table 8.9).

[160] Among the main factors contributing to these low levels of adoption of these activities is the low level of education (see chapter 3).

Table 8.9 Main sources of income compared between and within zones

		OVERALL	NCA	LGCA	LGCA Centre	LGCA periphery
Pastoralism	Count	117	56	61	32	29
	% within Zone	73.6%	73.7%	73.5%	64.0%	87.9%
Cultivation	Count	33	17	16	15	1
	% within Zone	20.8%	22.4%	19.3%	30.0%	3.0%
Wage employment	Count	6	2	4	2	2
	% within Zone	3.8%	2.6%	4.8%	4.0%	6.1%
Petty trade	Count	3	1	2	1	1
	% within Zone	1.9%	1.3%	2.4%	2.0%	3.0%
TOTAL	Count	159	76	83	50	33
	% within Zone	100.0%	100.0%	100.0%	100.0%	100.0%

According to Table 8.9, the NCA and LGCA had generally comparable proportions of households reporting cultivation as their main source of income (22.4% and 19.3%) respectively, but with significant variation between LGCA centre and LGCA periphery (30% and 3% respectively). The comparatively higher proportion of households reporting cultivation as the main source of income in the LGCA centre results from the predominance of cultivator niches in the area, and it explains the generally comparable proportions between NCA and LGCA. It follows therefore that the proportion of households reporting cultivation as the main source of income in the NCA (where there are no cultivator niches) may be considered rather high.

The non-significant proportion of households adopting economic activities other than cultivation, the fact that these activities are adopted together with cultivation, and the fact that NCA is disadvantaged in this diversification, suggest a situation of fewer livelihoods opportunities, particularly in the NCA. Conversely, this situation together with the proportion of households reporting cultivation as the main source of income, may trigger a gradual shift in the peoples' livelihoods perceptions, and put more emphasis on cultivation in the light of a non-growing livestock economy and in the absence of other livelihood opportunities.

8.5.3 Role of household (own) cultivation in pastoral economy

"In the past we were fed by our cattle. Now that we do not have enough cattle to feed our families, we have to cultivate". This was a common answer as to why a household was engaged in cultivation in the NCA, and Figure 8.2a sheds light on this 'past' and 'now'. Occasionally, others added information like: We need to minimize livestock sales; we need enough food; cultivation boosts one's economic situation etc., and these were common responses in both NCA and LGCA.

This section explores the contribution of household cultivation in the pastoral economy, so as to shed light on the future of both cultivation and pastoralism in the area. The main idea is to find out whether pastoralists are cultivating in order to reduce the effects of the economic hardships resulting from the apparent failure of the livestock economy substantiated above or otherwise. Areas explored include the contribution of household cultivation to food requirements, other household needs, and, herd building.

8.5.3.1 Contribution of cultivated crops to household food requirements

The overall importance of cultivated crop (mostly grain) in pastoral foods is substantiated in section 8.5.1 above. A comparison of proportions of grain consumed in 30 sub-households of the intensive sub-sample by different sources (from which the grain was acquired) pointed to own cultivation as the most important source of grain in the sample sub-households (Table 8.10).

Table 8.10: Sources of grain consumed in sub-households (multi-round data)

Zone		Total grain consumed (Kg)	% from own cultivation[161]	% from l'stock products	% from other sources
NCA (N =15)	Mean	12.8	39.3	30.7	30.0
	Std. Dev.	3.913	35.3	34.8	38.8
LGCA (N =15)	Mean	16.9	74.5	15.8	9.7
	Std. Dev.	8.470	22.1	15.7	18.2
Total (N = 30)	Mean	14.9	56.9	23.2	19.9
	Std. Dev.	6.815	34.0	27.6	31.5

Accordingly, own cultivation formed the largest proportion of cultivated crop in the meals (57%). Grain bought from the sale of livestock products (in this case milk[162]) accounted for 23%, and that from other sources accounted for 20% of the total gain consumed during the intensive multi-round study.

Own cultivation contributed to 74.5% of the total grain consumed in the LGCA as opposed to only 39.3% in the NCA. This significantly large difference is associated with two factors: one is that the sample sub-households in the LGCA were located in the LGCA centre, sites with significantly higher levels of cultivation compared to the rest of the sites in the study area. A part of the grain produced in these sites was sold or exchanged with livestock in the peripheral LGCA, therefore somehow supporting the pastoral system. The other factor is the restriction f cultivation in the NCA.

[161] Grain from own cultivation includes grain that was obtained through exchange (direct or indirect) with other crops cultivated in the household, mainly potatoes and vegetables.

[162] Several of the sub-households selling milk to purchase grain were the poorer ones. Their argument was that from 1 litre of milk, one could buy maize meal that can feed the sub-household for at least a meal, whereas that amount of milk would not be enough for even one individual (see table 8.4 for market prices).

8.5.3.2 Cultivation and other household needs

Common household needs among pastoral sub-households include non-pastoral food items like sugar, tea, salt, etc., and other non-food items like kerosene, soap, and tobacco to mention a few. These are commonly purchased at sub-household level through sales of pastoral products like milk, hides and skins, and, occasionally small stock. Household consumption is mainly in meeting costs of grain, acaricides/veterinary drugs, human medication, development levy, school fees, and clothing for the family. Most of these costs are associated with modernisation.

Information concerning household economy was collected from 30 sub-households of the intensive sub-sample through observations, recalls and discussions. The data covered different items purchased and the sources of money (for the purchases) as well as sales of different items (including livestock and livestock products and also cultivated crop) and the uses of money accruing. Recall questions covered sales/purchases since the last market day. (Market days had a fixed schedule known to the researcher and the respondents). The data was summarised and used to assess the contribution of livestock and cultivated crops in the household economy. Table 8.11 presents summary results.

Accordingly, own cultivation is shown to contribute significantly to the household needs. This contradicts the general hypothesis of a functioning pastoral economy where livestock sales (small stock or cattle depending on demand) ought to meet most of the household needs. One possible explanation for this deviation, particularly for the NCA is the small household herds, such that households had to avoid selling livestock. Actually, they were struggling to rebuild their herds now that they could access grain through cultivation and not through selling livestock, as it was the case during the period of cultivation ban.

Table 8.11 Frequency distribution: Observations of financial sources for items bought in 30 sub-households (multi-round data)

	Monetary sources for the purchased items					
Items bought or paid for	Cultivated crop	Livestock products	Small stock	Cattle	Other	Total
Food items (N = 125)	60.8%	25.6%	4.8%	0.0%	8.8%	100%
Vet medicine (N = 3)	33.3%	0.0%	66.7%	0.0%	0.0%	100%
Clothing (N = 8)	25.0%	12.5%	12.5%	0.0%	50.0%	100%
School uniforms (N = 2)	100%	0.0%	0.0%	0.0%	0.0%	100%
Livestock (N = 2)	50.0%	0.0%	0.0%	0.0%	50.0%	100%
Other (N =4)	25.0%	0.0%	0.0%	25.0%	50.0%	100%
All observations (N = 144)	57.64%	22.92%	6.25%	0.69%	12.5%	100%

N = Total number of observed purchases.

In the LGCA, the explanation could be the availability of ready markets for grain and livestock products (milk) in the Loliondo township, alongside the normal pastoralists' reluctance to sell livestock in conditions of these alternative avenues of meeting household needs.

Frequency distribution of consumer items purchased in the sample households and sub-households showed that financial sources for 57.6% of all the items bought during this period were household cultivation. Own cultivation was particularly important in the purchase of food items that are divisible (obtainable in small quantities) and/or demanding small amounts of money. It contributed up to 60.8%

of the observations. Pastoral products contributed 25.6% of these items, and small stock and other sources contributed only 4.8% and 8.8% respectively.

These observations do not only show the importance of cultivated crop in the provision of other household needs, but also its importance in saving livestock that could otherwise be sold to purchase these items. It is also important in the provisioning of consumer goods that would otherwise be lacking under conditions of insufficient herds. Own cultivation was therefore contributing in different livelihood aspects of the household.

8.5.3.3 Cultivation and herd-building

Two methods of herd building that are associated with cultivation were reported in the study area[163]. One was minimizing livestock sales for food or other households needs, thus retaining not only the numbers but also a larger base for herd reproduction. The other involved adding (into the household herds) other animals from outside the herd. The second method is commonly achieved through livestock-grain exchange or purchases using proceedings from cultivated crop. Table 8.12 presents the proportion of households that saved their animals by not selling them for food in the year 1999.

Table 8.12 Households that did not sell livestock for food needs, 1999.

Zone	Overall (N = 159)	NCA (N = 76)	LGCA (N= 83)	LGCA centre (N = 50)	LGCA periphery (N = 33)
Households	(81) 51%	(43) 57%	(38) 46%	(37) 74%	(1) 3%

[163] Pastoralists have several strategies of herd building but only those related with cultivation are considered in this discussion.

In the overall, 51% of the sample households saved all the animals they could otherwise sell in order to purchase grain. The saving was slightly higher in the NCA (57%) compared to LGCA (46%). Within LGCA, a significant difference was observed between sites in the LGCA centre where 74% of the sample households did not sell livestock for this purpose. In peripheral LGCA, only 3% of the sample households did not sell livestock for food.

These figures may not necessarily represent levels of food sufficiency achieved through own cultivation in the respective areas. Rather, they are a reflection of the proportion of households that would reduce the size of their already small herds in the absence of cultivation and other sources of grain. Based on the upper hand in grain available per household in the LGCA, the higher savings in NCA compared to LGCA are reflection of conditions of stress in livestock that had developed gradually in the period of cultivation ban. Variations within the LGCA are more or less a reflection of the existence of rather distinct land use units: sites predominated by cultivation (LGCA centre) and those predominated by livestock (peripheral LGCA); and the economic relationships between the two land-use units.

The contribution of own cultivation in herd building that involves adding animals from outside the household herd is presented in Table 8.13. The table provides easy inter-zone and intra-zone (LGCA) comparisons in terms of percent households by type of livestock added to their herds.

Table 8.13: Households that obtained livestock from own cultivation

Source of livestock	Type	Overall (N = 159)	NCA (N = 76)	LGCA (N = 83)	LGCA centre (N = 50)	LGCA periphery (N = 33)
Exchange: grain with livestock	Cattle	(29) 18%	(7) 9%	(22) 27%	(21) 42%	(1) 3%
	S/stock	(35) 22%	(16) 21%	(19) 23%	(18) 36%	(1) 3%
Purchase using proceeds from grain	Cattle	(36) 23%	(10) 13%	(26) 31%	(26) 52%	(0) 0%
	S/stock	(21) 12%	(9) 12%	(12) 14%	(12) 24%	(0) 0%

Overall, about 18% and 22% of the sample households obtained cattle and small stock respectively by exchange with grain. Another 23% and 12% purchased cattle and small stock respectively using proceeds from selling grain. There were more households in the LGCA that obtained livestock from own cultivation compared to NCA, and it was the LGCA centre which contributed to this difference. The LGCA periphery had a negligible proportion of households that obtained livestock through this method, basically because of the low levels of cultivation in these sites.

Livestock obtained through livestock-grain exchange and that purchased using cash from grain, all account to the contribution of cultivated crop in herd building. The former is a common practice in traditional pastoralism, whereas the latter is becoming more important in light of forces of modernisation that are incorporating pastoralists in the market economy. A few Maasai youths ***(murran)*** were using this method (cultivation for the purchase of livestock) to start their own herds on the argument that the 'traditional' methods of cattle rustling were no longer applicable in the present-day rule of law.

In addition to variations by zone, herd building through cultivation varied also by wealth. Table 8.14 shows variations (by wealth) in livestock obtained livestock through grain.

Table 8.14 Herd building by wealth[164]

Source of livestock	Type	Under 4.0 (N = 72)	4.01 – 8.0 (N = 35)	Over 8.0 (N = 19)	Overall (N = 126)
Exchange: grain – livestock	Cattle	(11) 15%	(7) 20%	(10) 53%	(28) 22%
	S/stock	(22) 31%	(9) 26%	(3) 16%	(34) 27%
Purchase using proceeds from grain	Cattle	(14) 19%	(11) 31%	(11) 58%	(36) 29%
	S/stock	(18) 25%	(3) 9%	(0) 0%	(21) 17%

Where conditions for cultivation were generally comparable (i.e. if we exclude the two sites with less involvement in cultivation), a significantly larger proportion of wealthier households (53% and 58%) obtained cattle through exchange and purchases respectively. About 20% and 31% of the households in the medium wealth recorded cattle obtained from exchange and purchases respectively compared to only 15% and 19% of the poorer ones. That a larger proportion of wealthy households increased cattle in their herds is associated with the difference in size of cultivated land and the ensuing harvests between the wealth groups (wealthier cultivate more land; harvest more grain). The implication is that cultivation in the rangelands becomes more beneficial to wealthier households, which, in addition to meeting food requirements, achieve higher increments in their livestock herds. This pattern leaves the poorer households at a comparative disadvantage, mainly because of their conditions of poverty which entails that

[164] Excludes households in peripheral LGCA in order to capture meaningful differences between wealth groups under conditions of comparable levels of cultivation.

most of the household requirements ought to come from cultivation, thus leaving only a little for herd growth.

With regard to small stock however, poor households (under 4 LE/RA) constituted a larger proportion (31% and 25% of exchange and purchases respectively) compared to the medium wealth households (26 and 9%) and also the wealthier households (16% and 0%). This pattern (in small stock) portrays a typical recovery strategy in staggering pastoral economies,[165] particularly among poorer households.

8.5.3.4 Pastoral wealth and cultivation in the rangelands

Chapter 6 showed that wealthier households are cultivating beyond the minimum subsistence requirements, and using the crop for herd building among others. Discussions and survey data suggested two interrelated factors that provide propensity for the higher levels of cultivation among these households. One was the respondents' social position which creates a larger demand for cultivated crop in that the households had more visitors, more friends/kinsmen and other people potentially seeking assistance from these wealthier households because they are 'wealthy'. It is within the social context of Maasai pastoralists and their definition of wealth that a wealthy household is one which, in addition to having large herds, has enough food for its family members and visitors alike. Such households have many livestock and grain friends, usually maintained through regular exchange of such gifts. Wealth is also linked with the household's social position, and

[165] Accumulation in small stock has a potential for quick herd recovery. Small stock has a higher annual increment and therefore quick increase in cattle on exchange.

households climbing this social ladder would do their best to maintain their position. Cultivation is just one of the means. Larger farms and correspondingly large harvests are a measure of their success. Therefore, wealth, and the associated need to maintain one's social position provide an important motive for larger levels of cultivation observed among wealthier households.

The other motive is the wealthier households' capacity to undertake cultivation of considerably large levels compared to poorer households. Firstly, wealthier households in the study area owned and cultivated the best lands. Transect walks identified several farms that could be classified as best agricultural lands in Endulen, Sakala and Wasso and KI discussions and also observations during data collection on individual household farms linked most of these farms with wealthy households, most of which held important positions in their community[166].

Secondly, wealthier households had a better command of labour for cultivation compared to poorer households. In addition to having relatively larger household labour (due to generally larger family size), they owned and used labour hired specifically for cultivation-related activities. Table 8.15 compares sources of labour between different wealth groups by zone. Moreover, wealthier households organised communal labour functions for cultivation activities more frequently than the poorer households did. Plate 8.5 shows hired labour in one of the farms belonging to a wealthy pastoral household in the LGCA.

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[166] Maro, (1994), Kivelia, (1995) and Mlay, (1974), reported similar observations among other pastoral communities in Arusha, Tanzania. Wealthier households were occupying/encroaching the best cultivable lands while pushing the poorer ones into more fragile, less cultivable lands.

Table 8.15 Cultivation labour compared between zones and wealth groups

Zone	Labour	Poor: Under 4.0 LE/RA	Medium: 4.0 - 8.0 LE/RA	Wealthy: 8.0+ LE/RA
NCA	Mean h/hold labour*	3.4	4.1	5.8
	% h/holds using communal labour	38.3%	45.0%	77.8%
	% h/holds using hired labour	12.8%	15.0%	44.4%
LGCA	Mean h/hold labour*	3.1	4.1	3.7
	% h/holds using communal labour	48.0%	80.0%	80.0%
	% h/holds using hired labour	4.0%	20.0%	40.0%
Overall	Mean h/hold labour*	3.3	4.1	4.7
	% h/holds using communal labour	41.7%	60.0%	78.9%
	% h/holds using hired labour	9.7%	17.1%	42.1%

- Household labour refers to all family members aged 15 years and above

Plate 8.5 Hired labour in one of the farms in Sakala Makalasinga (LGCA), Feb. 1999.

8.6 Changing perceptions in land tenure

Alongside the increasing importance of cultivation in the pastoral economy, there were indications that an attitude towards private ownership of land could be emerging. Several observations were made with regard to alien practices, which suggested that a sense of affiliation to, and ownership of, land that an individual could access or had accessed in the past was evolving. The observations below substantiate the changing perceptions.

8.6.1 Cultivation in evacuated lands and bomas

Traditional pastoralism in the study area is one of the nomadic nature. However, it has over time and in the context of policies leading to increasing sedentarisation and curtailing of pasturelands, developed into some form of transhumance pastoralism. Implied is that sedentarisation is increasing, and affiliation to lands they cultivate is growing. Strategies to achieve this included the return to lands that a household used in the past and creation of new bomas every after two to three years whereby most of the old bomas were transformed into farms owned by the same households. Table 8.16 presents a picture of these new developments in the rangelands.

Table 8.16 Bomas converted to farms 1995 - 1999

	NCA (N = 76)	LGCA (N = 83)	Overall (N = 159)
Moved to new bomas	23.7%	32.5%	28.3%
Owns evacuated bomas	18.4%	2.4%	10.1%
Cultivates evacuated bomas	15.8%	2.4%	8.8%

Though small proportions, they are important in that they mark the initial stages in the emerging notion of affiliation to land. Moreover, they are more important in specific population sub-groups and ecological regions, reflecting the effects of both socio-cultural integration and ecological changes. Nainokanoka and Oloirobi are but a few examples where *eleusine jaegeri* makes the opening of new farms difficult. Households therefore build new bomas every two to three years, and thereafter convert them into farms/gardens. In this way they evade the hard task of opening new farms in areas of *eleusine jaegeri*. Oloirobi is another example where non-Maasai cultivators had been evicted in the past. Two of these households had returned after the lift on cultivation ban and were clearing farms in a forest in the slopes of Mt. Malanje, arguing that it was their land prior to eviction.

8.6.2 Tree planting and permanent farm fencing

Evidence was obtained from transect walks and discussions which revealed that some of the fallow-lands in Sakala and Wasso were being fenced on a permanent basis or planted with trees, important symbols in warranting private ownership of land (Plates 8.6 and 8.7). Discussions with KI and owners of the farms as well as the survey data indicated that the farms belonged to resident Maasai who were wealthy (in terms of livestock) and were either educated or have had a leadership/civil service position in the government (Box 8.1. See also case No. 137 and Box 6.1 in Chapter 6). There were no such observations in the NCA.

Plate 8.6 A fenced plot in the LGCA to mark one's property.

Plate 8.7 A farm planted with trees alongside food crops (to mark ownership)

While fencing and tree planting marks the initial steps towards private ownership of land, maintenance of land as private property, i.e. acquiring the user rights for that land is made possible by virtue of it being under cultivation. Invested labour in the initial stages of clearing land for cultivation instigates the changing perceptions towards individual ownership of that land.

Box 8.1 Changing perceptions in land tenure

Case No. 114
ID No. 2514101; Age: 45; Education: 4; TLE: 80.2 Ethnicity: Maasai

- Owns 15.5 acres in total; 4 of which are planted with trees, another 4 are fallowed.
- Says: The situation is changing. Most of the common lands in the past have now been allocated to individuals as farms. I think it won't take long before land becomes an asset to be sold and inherited.

Case No. 134
ID No. 2614101; Age: 56; Ethnic group: Maasai; Education: 4; TLE: 98.5

- Owns 20 acres, 15 of which have remained under fallow since the collapse of barley crop in 1993.
- Says the fallow land is household property, to be inherited by his children. Has started planting trees in the fallow land.
- Thinks that cultivation may become more important in the future, and that all the land will be owned as private property.

8.7 Summary

This chapter has shown that the livestock economy in the study area can no longer meet subsistence requirements of the pastoralists, and conservation and development policies do not seem to have done much to alleviate this problem. As a result, the pastoralists are adopting other livelihood activities based on natural resources, and cultivation is the main activity adopted by almost all households in areas considered suitable for crop production. Own cultivation is playing an important role in supplementing household subsistence needs and herd building. However, it is through converting the rangelands to croplands, including the dry season refuge pasture lands. Moreover, there are indications of an emerging shift in food types and changing perceptions in land tenure among pastoralists. This, together with other factors discussed in chapter 7 may, over time, initiate and/or instigate the development of cultures and practices that are less pastoral-oriented in the study area.

It follows therefore that deliberate policies aimed at ensuring growth in livestock economy in the study area have to be effected because one of the objectives of establishing these buffer areas that accommodate pastoral communities alongside wildlife was to safeguard and promote the interests of the resident pastoralists. This was clearly stipulated on the creation of the NCA as a multiple land use area[167]. Other objectives were conservation and development of natural resources and the landscape, and, promotion of tourism. It is the integration of the three objectives that makes the area unique. Above all, it is the consideration of the needs of human populations residing in these buffer zones alongside the needs of conservation that will harmonise the co-existence of pastoralists and wildlife, making it a 'real' multiple land use area. This has an implication of practical policies that support pastoralism as a means of livelihoods, thus ensuring a sustained future for both pastoralism and wildlife land uses in the area.

[167] See Runyoro, 1996; MTNRE, 1995; URT, 1996; Shivji & Kapinga, 1997; Fosbrooke, 1988; Parkipuny, 1985 & 1996.

These suggestions however, do not undermine the importance of the traditional small-scale cultivation by pastoralists, particularly in supplementing pastoral household needs and in herd building. Therefore, policies and strategies to alleviate the pastoral economy ought to consider also the development of controlled small-scale cultivation.

CHAPTER 9

DISCUSSION AND CONCLUSION

"People who are starving will have no interest in conservation and without conservation people will eventually starve." (Brandon and Wells, 1992)

9.1 Introduction

This chapter presents the main points drawn from the results of this study as a way of final discussion in relation to cultivation trends in the buffer zones of the East African rangeland protected areas. These buffer zones, which allow human habitation, are created for the conservation of biodiversity in that they provide a gradual transition from the core PAs to the outer, intensively utilised regions (Dasman, 1983; McNaughton, 1989). In this regard, wildlife and pastoralism are viewed as the appropriate, conservation-compatible land-uses (Amuyunzu, 1997; DSRS, 1994; MTNRE, 1996). However, these buffer zones are increasingly being converted to croplands, although with considerable spatial variations reflecting the influence of the varied land-use policies (conservation-biased or development-biased) operating in different buffer zones, and also variations in ecological conditions and other socio-economic factors. The increase in cultivation is viewed as threatening the future of both pastoralism and conservation objectives.

The study was set in a context of two different land use policy zones, both under the challenges of increasing human needs. On one hand, there is the NCA land-use zone, managed under conservation-biased policies, which put controls on human activities in the rangeland resources, including their conversion to cultivation. Here there is control over in-migration as a way of limiting the influx of cultivators into the zone, so that it remains primarily under conservation compatible land uses – pastoralism, wildlife conservation and tourism. In this zone, there are views that conservation policies that regulate access and management/use of the pastoral resources, particularly the restrictions on cultivation, have created conditions of stress on pastoral livelihoods. On the other hand, there is the LGCA land-use zone managed under development-biased policies, thus allowing all forms of human activities except hunting (which is regulated). In-migrants, who may bring into the zone land-use practices that do not conform to livestock/wildlife land-uses, are also allowed. In this zone there are views that policies, which do not restrict cultivation, are essentially meaningless on the argument that the security of wildlife is inherently tied to that of natural habitat.

It is in this context of different (and sometimes conflicting) conservation and development policies, and in the light of spatial variations in the range resources and the challenges of increasing human needs that this study set out to investigate socio-economic factors driving the increase of cultivation in the buffer zones of the East African rangeland protected areas. Specifically, it set out to answer the following research questions:

- Where is most cultivation taking place (in relation to spatial variations in ecological conditions and other socio-economic factors on one hand, and the influence of conservation and development policies on the other)?
- Who converts the rangelands to croplands and why?

- How have the policies influenced the increase of cultivation in the rangelands in general and among pastoralists in particular? The former focuses on the way different policies have encouraged conversion of the rangelands in general, and the latter considers the way these policies have promoted pastoral livelihoods in the area (or otherwise), on the argument that policies that do not facilitate growth in the livestock economy do encourage cultivation.

A total of nine study sites (four in the NCA and five in the LGCA) that could allow inter- and intra-zone comparisons were chosen. The household sample included population sub-groups of different socio-economic characteristics so that they can be compared in terms of their contribution in the increasing conversion of the rangelands. Questionnaire surveys, key informant interviews and discussions, participant observations, physical measurements and counts, were employed in data collection. Remotely sensed data on trends in land cover change was obtained from Louvain University. The data were used in analyzing the temporal and spatial patterns of cultivation and land cover change, analysis of actors and factors behind the increasing cultivation in the buffer zones, examining livelihoods diversification activities (including the role of cultivation in pastoral livelihoods) among pastoral households, and, in so doing, comparing the outcomes of conservation and development policies between the two zones. The results are summarized below.

9.2 Spatial patterns of cultivation

The study investigated the spatial patterns of cultivation in the buffer zones and the associated land-cover change in the light of the influence of the conservation and development policies alongside spatial variations in ecological conditions and other socio-economic aspects. The findings in this regard are summarized and discussed below.

9.2.1 Spatial distribution of cultivation in the NCA and LGCA

The findings on spatial distribution of cultivation reflect the varied influence of conservation and development policies alongside ecological and socio-economic factors. Comparisons between the two zones showed that there is more land converted to cultivation in the LGCA compared to the NCA despite the more favourable ecological and accessibility conditions of the NCA. However, there is a higher proportion of cultivating households in the NCA (96%) compared to LGCA (87%). This suggests that the two zones may, over time, achieve comparable levels of cultivation (given that cultivation in the NCA was allowed only recently and the majority of households were intending to increase the size of their farms, and that considerably large tracts of farmlands are coming under permanent fallow in the LGCA following the closure of the barley project and its associated market and other incentives for the crop).

There was also an interesting difference between the two zones regarding the anticipated gradual transition of land-use intensity from core PAs towards the outer, intensively used lands. In the LGCA, the intensity of cultivation decreases with diminishing conditions of accessibility to roads and potential markets, which are not quite related with distance from the core protected area, i.e. the Serengeti National Park. As such, the pattern is one of patches of relatively intensive land-use that do not conform to the purposes of creating the buffer zone.

In the NCA, cultivation was generally confined to the cultivation blocks zoned by NCA authorities, and a few traditional small plots surrounding the homesteads. Higher acreage per household was observed in the less accessible areas, particularly those bordering cultivator communities outside the zone. This has resulted in a spatial pattern of generally decreasing intensity (of cultivation) from established cultivators (outer borders of the zone) towards the core PA, reflecting some form of conformity with the purposes of which the buffer zone was created. Conversely, factors of accessibility are of little importance regarding intensity of cultivation in this zone. However, the higher acreage in less accessible and/or border areas is an indication of increasing pressure of cultivating households from within and outside the zone, in areas where they can circumvent the law. This observation suggests that the needs of these people have to be harmonized with those of conservation if the objectives of creating the buffer zones are to be achieved.

9.2.2 Cultivation and land cover change (LCC)

The main motive behind the investigation of land cover change alongside increasing cultivation was its consequences on range resources, i.e. loss of vegetation cover and pastures in general, and, in particular, range resources of specific importance to wildlife and livestock, e.g. wetlands that would otherwise provide crucial dry season refuge pastures. These wetlands fall victim to cultivation because of their overlapping potentials. Moreover, the wetlands fall victim to increasing sedentarisation associated with settlement policies and in-migration (which may bring into the rangelands less pastoral oriented cultures).

In this study, it was found out that there was a slight increase in loss of vegetation cover in settled areas, signifying the contribution of permanent settlements introduced in the rangelands by the national settlement policy/scheme of 1975/76, and, of course, increasing cultivation alongside sedentarisation. Overall, settled areas that registered high mean acreage of cultivated land per household also registered high rates of land cover change associated with human activities.

The magnitude of LCC associated with cultivation was slightly smaller in the NCA compared to the LGCA. Moreover, there were indications (though slight) that land cover change was increasing in the LGCA and decreasing in the NCA, although ecological and accessibility factors (that could encourage declines in vegetation cover associated with human activities) are generally in favour of the latter.

Comparable observations were made in a parallel study in the buffer areas of the Kenyan side of the SEU. Accordingly, the magnitude of LCC was higher in the Kenyan buffer areas compared to the study area in Tanzania. (See chapter 5 Table 5.1 and Appendix 5.1). Also, inter-zone variations similar to those observed between NCA and LGCA were observed between the Kenyan inner and outer

GRs. According to Thompson (2002), the inner GRs had relatively smaller areas of land converted to cultivation as opposed to the outer GRs which are subjected to mechanized cultivation, high rates of change in vegetation cover and consequent losses in biodiversity. The main contributing factor was the privatization of the rangelands, which allowed leases and sales of land to in-coming cultivators[168].

A potential problem area of the increasing cultivation in the rangelands pointed out in literature was the conversion of crucial range resources to croplands, especially wetlands that are commonly used as dry-season refuge or pasture for calves and sick animals (*olokeri*)[169]. Such conversions are viewed as interfering with the pastoral land tenure and grazing patterns, and may even weaken the pastoral economy and livelihoods.

In this study, only a few cases reflecting two different scenarios were reported and/or observed in this regard. Firstly, there were few cases (observed) of wetlands (*olokeri)* converted to croplands by individual households in the settled areas. These were conversions agreed upon by the land managers (herein the villagers) in a context of abundance of such crucial resources within a locality, and were within village and locality land-use plans. Two such conversions were observed in LGCA, in areas dominated by pastoralists (see chapter 5, page 112). The second scenario was that involving large tracts of land delineated from the

[168] See Thompson, 2002; Homewood et al. 2001; Grandin, 1988; Graham, 1988; Amuyunzu, 1997
[169] See Scoones, 1991, 1992; McCabe, 1990, 1997; Galaty, 1994; Potkanski, 1996; Parkipuny, 1997.

pastoral and wildlife pastures under the influence of the central government administration[170]. This has resulted in resentment/complaints about curtailed pasturelands from the pastoralists and about the future of wildlife (see plates 7.2 and 7.3; also chapter 8, p.214). Cases comparable to the second scenario had also been observed in the Tanzanian Barabaig pastoral lands (see Lane, 1996).

The above observations regarding variations in patterns and trends in land cover change are attributed mainly to land-use policies practiced in these buffer zones[171]. They are indicative of the problems of the resultant land-use patches (cultivated zones and protected areas) in a rather continued rangeland ecosystem, especially with reference to movements of livestock and wildlife. They are also supportive of the relevance of somewhat centralised controls over rangeland resources so as to enhance fluid land management in the buffer zones.

9.3 Who converts the rangelands to croplands? Why?

Documented literature and research findings have painted in-migrants (from cultivating communities outside the buffer zones) and large–scale government-backed cultivation projects as the main actors in the conversion of the East African rangelands[172]. Their motives include those related to land entitlements and economic returns per unit of land (especially under privatised land tenure systems), and also market forces.

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[170] The case of TBL farm refers (see chapter 7, p. 170).

[171] Policies in the Kenyan part of buffer zones are development oriented, in the context of privatized ownership of the range resources (individuals or groups). In Tanzania, land is generally owned by the State, which delineates land to be managed under conservation or development-biased policies.

[172] See Lane, 1996; McCabe, 1997, MTNRE, 1996; Parkipuny, 1995; NLUPC, 1994.

With regard to NCA, evidence from literature and research had, until 1997, painted in-migrants and wage earners as the culprits of rangelands conversion, cultivating farms of up to or more than 4 hectares (McCabe, 1997). In the LGCA, the main actors were shown to be in-migrants and the now defunct barley project scheme of the TBL. In both zones, resident pastoralists were shown to practice only small-scale subsistence cultivation.

In this study, the findings do not support the allegations against in-migrants and wage earners. These were the minority population sub-groups who cultivated relatively small farms that are generally comparable to, or even smaller than, those cultivated by the majority of the resident pastoralists. The only sub-groups with relatively higher acreage than the other sub-groups were the livestock-rich pastoralists and a few residents who had retired from government service or political leadership positions. These sub-groups could, by virtue of their economic positions, convene extra labour to supplement that of the household and access the best cultivation niches in a locality. In general, all of the population sub-groups were involved in cultivation. What differentiates them is the scale of cultivation. Some were cultivating to a scale slightly higher than the traditional 'small-scale' pastoralists' cultivation.

This study has established that the main motive behind the increasing cultivation in the rangelands is subsistence. Research evidence abounds in regard to the gradually declining ratios of livestock to human populations in a context of a rapidly increasing human population in the study area, leading to an increase in the proportion of grain in the pastoral foods[173]. In the absence of other reliable sources of income and/or employment that could ensure reliable access to grain, own cultivation becomes a viable option. However, new crops in the study area were linked with in-migrants and non-Maasai residents. The crops were market-oriented, suggesting the influence of market factors over the increasing cultivation alongside subsistence needs, particularly among in-migrants and non-Maasai residents.

The other motive behind increasing cultivation, particularly among pastoralists and in a context of dwindling livestock herds per household, was herd building. Involvement of households and individuals in cultivation was not only saving livestock from sales associated with subsistence needs but also increasing their numbers through exchange of livestock with grain and/or purchases of livestock using proceeds from sales of cultivated crops. Wealthier households were cultivating significantly larger farms to maintain their positions in the society. They were having generally larger families and they were obliged to give out gifts (grain and livestock). This observation supports small-scale traditional cultivation among pastoral households as necessary livelihood strategy that will promote pastoralism as the major livelihood activity in the study area.

Other motives revolve around tenure issues. Some wealthier households owned land for cultivation in areas around Loliondo township (while keeping their large herds in the peripheral sites); some were claiming ownership of large tracts of

[173] See for example Homewood and Rogers, 1991; McCabe, 1997; CSI and FZS, 1997.

fallow land; and, there were observations of tree planting and fencing in some of the farms. Moreover, some in-migrants were moving into the study area in order to acquire land (allocated to them by the village government). All these observations are, in this study, interpreted as indicators of an emerging deviation from communal to private ownership of land. In this context, and in a political environment where modern, imposed tenure rules overrides the traditional mechanisms of control/access to land, households from different socio-economic and cultural backgrounds may cultivate for the purpose of justifying land ownership.

Briefly, population sub-groups of varied socio-economic characteristics contribute differently to the increasing cultivation in the NCA and LGCA. Wealthier, resident pastoralists are more important in this conversion because of their social and economic positions in the society. The main motive is subsistence, which goes hand in hand with herd building, although motives related to systems of land tenure and market forces seem to be emerging gradually.

9.4 The influence of policies

Differences in conservation and development policies generally explain the observed variability in the increasing cultivation in the two zones. In the NCA, conservation biased policies play an important role in regulating the rate and magnitude of rangelands conversion, keeping cultivation at low levels compared to those in the LGCA. The centrally administered zoning of cultivation blocks, control on in-migration, limitations on who may and may not cultivate as well as the restrictions on tools and inputs to be used limits not only the number of cultivators in this zone, but also the amount of land to be cultivated. Otherwise, levels of cultivation up-take in the NCA would probably be higher than in other buffer areas given the generally conducive ecological (climatic) conditions access to roads/transport infrastructure, and the pressures from the surrounding cultivator communities who are in dire shortage of land for cultivation[174].

In the LGCA, such regulations were non-existing. In-migrants were allowed in the zone without any conditions other than the normal procedures (of presenting an identification paper from the village of origin), and the village political/government administrators allocated them land for cultivation. Large tracts of land however, were allocated by the district level administration. In this way, the development-biased policies in the zone did not regulate but generally encouraged conversion of the rangelands. Luckily, according to remotely sensed data, the impact on land cover change so far is not much. However, measures to regulate this should not wait for irreversible conditions.

Some of the conservation-biased policies employed in the NCA were associated with higher declines in household herds in the NCA compared to the LGCA (LE/RA was 3.0 in the NCA, and 5.5 in the LGCA). The argument was that, during the period of cultivation ban, pastoralists were obliged to stretch their livestock sales (to purchase grain) beyond sustainable levels, selling beasts of

[174] Problems of insufficient land for cultivation, and in some cases serious population pressure are reported in many communities bordering the Eastern and Southern border of the NCA. See for example, MTNRE, 1996; Maro, 1994; Kivelia, 1995.

significant value to pastoralists which they would otherwise avoid to sell[175]. In this study, there were no reports/findings of livestock sales involving cows, let alone lactating ones. The only cows sold were those seen by the owners as unsuitable to the pastoralists (e.g. cows considered unproductive). The explanation to this is that now, with cultivation, they can do without selling over-stretching their livestock sales. Moreover, there was no adequate evidence that conservation and development policies were effectively addressing livestock problems so as to foster growth in the livestock economy in study area.

It is in these contexts that NCA conservation policies of the past decades have been blamed for overlooking the well-being of the NCA pastoralists in favour of conservation of biodiversity. In the same vein of argument, development policies have overlooked livestock development (an economic activity that provides livelihoods to the pastoralists), therefore failing to support pastoralism - a land-use compatible with wildlife conservation. Yet, both the needs of humans and those of biodiversity conservation are important if the purposes for which the buffer zones are created are to be achieved.

9.5 Conclusion

The general stance in the literature is that the East African rangelands have, over decades, been managed under conservation compatible uses, i.e. wildlife and pastoralism, and that the increasing cultivation is a threat to these uses and

[175] Potkanski, 1995; McCabe, 1997 reports sales of cows, including lactating ones, for the purchase of grain. Under normal circumstances, pastoralists do not sell cows (except those viewed as unproductive), let alone lactating ones.

biodiversity in general. This study has shown that cultivation is increasing, and where this is taking place without conservation-biased controls, it is likely to encroach range resources of significant value to both livestock and wildlife. For this reason, there is need to manage all the buffer zones in a way that caters for both the needs of the growing human population and those of conservation of biodiversity. There is need to control not only the size and quality of converted lands but also other forces increasing the conversion, e.g. in-migration.

There should be management practices cum policies that foster growth in the pastoral economy. This includes among other aspects of livestock development (improvements in dipping and veterinary facilities, markets for livestock and livestock products, availability and affordability of grain, ètc.), allowing pastoralists to access the varied grazing resources in the wider ecosystem throughout the year alongside their small-scale cultivation. Goldman (2003) correctly observes that Maasai pastoralism relies on access to various patches of grazing resources across the larger ecosystem, and that the seasonal movements of their cattle is similar to the migratory movements of wildlife. This is in support of the long history of co-existence of pastoralism (that incorporates small-scale cultivation) with wildlife, which shows the degree of complexity of land uses the Maasai have adopted in these rangelands. This co-existence does not really support strict controls on pastoralists' access to and management of the range resources. Rather, it advocates control/restriction of non-pastoral in-migrants because they are not adequately adapted to the complex environments of the rangelands.

The increase in traditional small-scale cultivation among pastoral households due to subsistence needs that are not met by the livestock economy (in a context of increasing human populations without a corresponding increase in livestock numbers) calls for strategies that can minimize the increase in converted lands while at the same time catering for the needs of conservation. This implies controlling cultivation at low (probably the current) levels, but in such a way that it becomes a productive activity[176]. Improving their basic socio-economic needs (health, education, extension facilities, etc.) to levels comparable to other rural areas in Tanzania, and then training them on appropriate farming methods and technology, and ensuring availability of appropriate inputs for improved productivity per unit of land could be one of the means. However, such improvements may attract in-migration and other forms of human cultures and scales of cultivation in the buffer zones. These should be controlled, and emphasis should be on the improvement of pastoral livelihoods and therefore pastoralism, which is considered to be compatible with the purposes of creating the buffer zones[177].

The current community based conservation (CBC) initiatives being led by the AWF, TANAPA and the wildlife division of the MNTRE, which creates new ecological divisions that portion the landscape in a way thought to cater for the

[176] In this study, the observed yields per unit of land were generally low, partly because of poor farming technology, late sowing, lack of appropriate inputs etc.

[177] Research evidence abounds on the compatibility of wildlife conservation and the traditional pastoralism that incorporates small-scale cultivation practiced by Maasai in the SEU. Wildlife in the Maasai occupied corridor of Kwakuchinja between Tarangire and Manyara National parks is just one of the many examples (TCMP, 2002; Voeten et al.; 1999).

conservation and development needs could be a viable option. However, it should not ignore the role of the traditional small-scale cultivation in the rangelands. Small-scale cultivation has been shown to be a vital component of the pastoral livelihoods. It should be incorporated in the CBC approach if the buffer zones are to be managed under pastoralism and wildlife conservation.

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APPENDICES

Appendix: 4.1 Summary Results: Ecological traversing and key informant discussions, NCA and LGCA. April - June, 1998

Zone	Settlement	Location and socio-economic infrastructure	Occupancy history, occupational background & residential status	History and patterns of cultivation	Comments
NCA	Alaililai	• In the crater highlands, 8 Km north of Nainokanoka, no road, 25 Km from Sopa Lodge	• Very few bomas in 1960's. Most residents by 1975 - 76 • Indigenous Maasai, very few settled Waarusha	• Mainly maize, in valley bottoms and slopes • Large tracts of cultivated land, in plots of 1 to 3 acres • Considerable distance from farms to homesteads (some up to 1 Km)	• All flat lands and considerably steep slopes were under cultivation. • Little cultivation in slopes considered too steep
	Nainokanoka	• In the crater highland zone, 17Km from Sopa Lodge (tourist) • Ward HQ, • Normal social services • A seasonal road to Sopa, then an all weather road to NCA and Karatu urban centre	• Evidence of settlement well before 1940's • More bomas in 1975-76 (villagization) • Mixed population: settled agro-pastoral Waarusha and indigenous Maasai pastoralists (larger %)	• Plots of Irish potatoes and vegetables in former stockades close to homesteads (approx. 1.0 acre/household) • Maize in valleys and slopes; plots 2 -3 acres • Cultivation of potatoes increased mid 1980's (after Sopa) • Multi-cropping potatoes, single season maize • Most potatoes sold to Sopa Lodge, Karatu • Most/all households cultivating	• Noted a trend of building new stockades to release older ones for potatoes • Informed of some households cultivating maize in other villages
	Irkeepus	• Located in same transect as Nainokanoka, approx. 10 Km. from Sopa Lodge	• Very few homesteads in the 1960's; majority in 1975 - 76 • Mainly indigenous Maasai pastoralists	• Plots of Irish potatoes in former stockades, plots less than 0.5 acres. Cultivation started to increase in the 1990's. • Potatoes sold to Sopa Lodge and Karatu	Interesting contrasts with Nainokanoka: • smaller plots, no indication of increasing plots

	Endulen	• Located in the western plains towards SNP boundary • A generally all-weather road cuts through; linking with NCA HQ & Karatu township (50 Km?) • Most services: including a hospital and a police post.	• Mixed populations: Wage employees, in-migrants and settled agro-pastoralists dominate the centre, with few indigenous pastoralists • Generally, the indigenous pastoral Maasai dominate the peripheral settlement niches	• Cultivation atypical to the indigenous "mabustani": -- Maize, & some beans • Larger farms (1.0 to over 3 acre plots); considerable distance from residential units; agglomerated into singular large tracts • Land use plans indicating blocks for cultivation. • Blocks not exhausted yet, trends show they will be in the near future	• Lorries brought in or shipped away grain during the dry season depending on harvest • households of different socio-economic backgrounds cultivate
	Oloirobi	• Located close to the NCAA HQ, along Arusha – SNP main road. • Most services available	• Mainly indigenous Maasai from Crater (1974); few non-Maasai • Pockets of petty traders and employees	• Little cultivation – maize, vegetables, potatoes, tobacco. • Land-use plans showing cultivation blocks	Similar conditions to Nainokanoka, smaller scale of cultivation.
	Olbalbal	• North of Olbalbal swamp; seasonal road to NCA - SNP road • Normal services	• Indigenous pastoralists, • few, settled a/pastoralists	• Cultivation of maize, farms 1 -3 acres • Maize and some beans (v. little) • Land use plans indicating blocks for cultivation. • Blocks not exhausted yet, trends show they will be in the near future	Few cultivators residing in neighbouring villages
	Meshili	• Located in the same transect as Nainokanoka, very close to Sopa Lodge. A sub-village of Irkeepus	• Few homesteads in the 1960's. Majority settled in 1975/76 • Mainly indigenous a/pastoralists	• Livestock rearing & small-scale cultivation, mainly potatoes and vegetable, sold to Karatu and Sopa Lodge	Cultivation at a generally smaller scale compared to Nainokanoka
LGCA	Samunge	• In southern slopes of Sonjo hills • Seasonal road to Loliondo township, 57 Km • Normal services	• Indigenous agropastoral cultivators • Very few in-migrant cultivators	• Maize domination, few other food crops • Both rain-fed and irrigated farms • Two crops with irrigation, one in rain-fed farms • The whole river valley (irrigated) is cultivated, plots from 0.5 acres to 1.0 acres. • Large rain-fed farms (3 to over 10 acres)	• Bush clearance for cultivation is very high.

	Digodigo	• In same transect with Samunge, 62 Km from Loliondo, • Normal services; Ward HQ	• Indigenous agropastoral cultivators • Very few in-migrant cultivators	• Maize, with few other crops • Irrigated and rain-fed agriculture, two crops with irrigation • Small irrigated plots (mostly less than 0.5 acres) • Large rain-fed farms (4 - 7 acres)	• Human populations have outgrown available irrigable land • Bush clearance for cultivation and settlement increasing in the outer ring
	Ng'arwa	• 5 Km north of Loliondo township, about 15 Km to the Kenya-Tanzania border. • Seasonal road from Loliondo through the village to Kenya • Most services from Loliondo	• Indigenous Maasai pastoralists • Few bomas before 1975; More by 1975/76, mainly from Sakala (a settlement with a long history of cultivation) and other areas within LGCA	• Maize dominates. Also few vegetables • Fields agglomerated into large blocks • Plots between 1.0 and 4.0 acres per hh • Use of ploughs	• Land use plan integrating cultivation and pastoralism
	Sakala	• Adjacent Loliondo, 3 Km from Loliondo township, 0.5 Km from the road. • Most services available, including the services of the district hospital	• Mixed population: Settled agropastoralists, in-migrants, few wage earners, few indigenous Maasai pastoralists • High density, not much affected by the 1975/76 villagization	• Maize dominates. Also vegetables and beans • Clear patterns of agricultural niches, i.e. much of the land in the vicinity of the settlement is under crop production. Pastures are in the outer ring • Fields from 1 -3 acres	• Symptoms of land sub-division observed • Monetary transactions in land acquisition mentioned as emerging
	Wasso	• Southwest of Loliondo, 8 Km along the road to NCA/Arusha • Growing into a township • Most services, including a hospital, District Council HQ, an air strip and a district market	• V. few settlements before 1975 • Increased in 1980's (on transfer of the HQ from Loliondo) • Mixed populations: migrants, wage earners, settled agropastoralists	• Maize and beans dominates • Large individual farms (1.0 to over 10 acres) • Expansive blocks of cultivated land	• New farms coming under cultivation
	Soitsambu	North of Loliondo town, a few Km from the Kenyan border Few services available	• Settled since 1950's • Mixed populations, majority Maasai; some from Kenya • Several services available	• Cultivation; reasonably large farms since 1980's alongside pastoralism	• Cultivation is increasing. Pastoralists opening up new farms, with the help of the plough

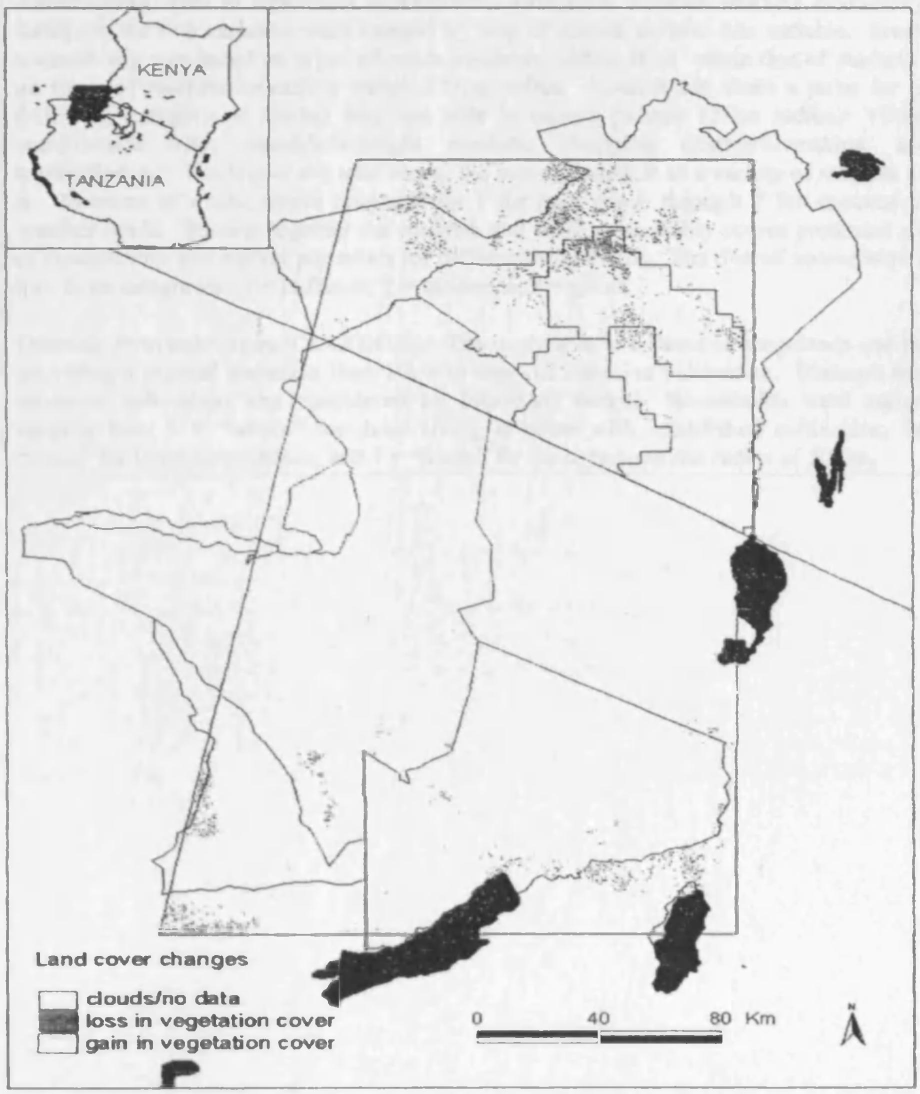
	Enguserosambu	• Northwest of Loliondo town • Several services available	• Settled since 1950's; mainly Maasai agro-pastoralists • Few non-Maasai.	• Cultivation; relatively large farms with pastoralism	• Cultivation is on the increase. New farms were coming under cultivation, and more cultivators were coming to the village
	Ololosokwan/Sero	• Located in the north west border of the SNP • Some services, including a secondary school. • Sero is a sub-village in the north-most location	• Mainly pastoral Maasai in Ololosokwan proper (majority from the greater Serengeti) • Non-Maasai in Sero sub-village (relocated from Loliondo and Sakala in the 70's)	• Pastoralism and tourist-related activities in Ololosokwan proper; • Significant cultivation alongside pastoralism in Sero sub-village. Maize and beans dominate	• Currently no significant increase in new farms or in-coming cultivators
	Arash	• Located over 40 Km south of Loliondo town • Few services	• Mainly Maasai pastoralists. Very few non-Maasai	• Mainly pastoralism. • V. small cultivation; small in scale	• No indication that cultivation will increase in the near future

Appendix 5.1: Land cover change (LCC) in the SEU 1975-1995

	Kenya			Tanzania		
	MMNR	Inner GR	Outer GR	SNP	NCA	LGCA
Change 1975-87	0.9	3.2	5.3	3.8	1.9	1.1
1987-95	0.3	7.1	13.0	1.4	0.8	1.5
Overall change 1975-1995	1.2	10.3	18.3	5.2	2.7	2.6

Note: Maswa GR (conservation without human activities) on the western border, had an overall change of 19.3% (probably due to climate and illegal human activities).

APPENDIX 5.2 LAND-COVER CHANGE IN THE SEU, 1975 - 1995



Appendix 5.3 Definition of spatial variables used in the analysis of distribution of cultivation

Ecological conditions. The study sites are located in areas of varied climatic conditions: The highlands zone of NCA with high rains and low temperatures (Nainokanoka and Oloirobi); areas of moderate climate (Endulen, Nayobi, Sakala, Wasso, and Ng'arwa); region of transition between moderate and less rains (Ololosokwan); and, areas with less rainfall (Arash). The climatic conditions work in combination with soil conditions and terrain to result into sets of broad ecological factors that influence cultivation. These include, in addition to the influence of climate on crop types and yields, conditions that may limit cultivation technology or labour productivity (e.g. slope, difficult soils etc.) and ultimately size of land cultivated. Nainokanoka, Oloirobi and Arash fall in the category poor ecological conditions (ECOLOGY = 1); Ololosokwan falls in the category of moderate condition (ECOLOGY = 2), and the rest are in the category of favourable condition (ECOLOGY =3).

Accessibility: Due to significant overlap/auto-correlation between markets availability and road transport, the two variables were merged by way of scores, to form one variable. Scoring of road accessibility was based on types of roads available within 5Km[1] while that of markets was based on types of markets accessible within 15Km radius. Households score a point for each of the following category of market they are able to access (within 15Km radius): Village centres, ward/dvision HQ, monthly/fortnight markets, shopping centres/townships, and, tourist centres/lodges. The higher the total score, the more accessible to a variety of markets a household is. In terms of roads, scores ranged from 1 for poor roads through 2 for seasonal to 3 for all weather roads. Pooling together the markets and road accessibility scores presented a continuum of accessibility and market potentials for different households. The overall scores were suppressed into three categories: 1 = Difficult; 2 = moderate; 3 = good.

Distance from cultivators (CULTDIST): The study area is defined as rangelands and buffer zones providing a gradual transition from PA's to areas of intensive cultivation. Distance from areas of intensive cultivation was considered an important factor. Households were assigned values ranging from 3 = "within" for those living in areas with established cultivation, through 2 = "close" for those up to 20Km, and 1 = "away" for those beyond the radius of 20Km.

[1] The district defines 'fairly accessible households by road' to be those within 5Km distance from the road. The roads (in the district) however fall into two categories: All weather roads and seasonal roads (NLUPC, 1984). A third category was developed (for the purpose of this study) to incorporate of some sites which did not fall in any of the above categories. This was a category of seasonal roads (appearing in maps) that were in practice, overwhelmingly difficult or virtually non-existent (e.g. the road linking Nayobi with Nainokanoka and the rest of NCA).

Appendix 5.5: Estimating Livestock Equivalents (LE) and Reference Adults (RA)

1. TLU and LE

Livestock biomass is commonly calculated in terms of total Livestock Units (TLU) or Livestock Equivalents (LE), whereby all species are reduced to comparable units. Different studies in EA employ diferent measures in calculations of TLU and/or LE.

FAO Year book (1962):	1 TLU = 1 camel = 0.8 cattle
Little (1985):	1 TLU = 1 bovine or 6 ruminants
Grandin (1988) :	1 TLU = 0.71 cattle = 0.17 shoat
Potkanski (1997)	1 TLU = 1 cattle = 7 small stock

In this study, Potanski's values were used to calculate LE for two reasons:

1. The pastoralists in the study area attach values rather similar to these, especially where exchange is concerned. A bull or a cow can be exchanged with an immature heifer, a steer or seven shoats.
2. The present study focuses more on the contribution of livestock to subsistence rather than the analysis of different livestock parameters.
3. The data was collected in a manner that do not allow sex and age discriminations required for other the calculation of other values.

Reference Adults (RA)

The conversion adopted in this study is that of adult equivalents (AE) used by Homewood and Rogers (1991:222) as it provides a base for time-series comparisons in the area, and it enables comparisons with other Maasai communities in Kenya where similar conversions had been used. The conversions are based on age and sex as follows:

Age	Sex	AE
Under 2 years	M/F	0.3
2 - 4 years	M/F	0.4
5 - 9 years	M/F	0.6
10 - 14 years	M/F	0.9
15 - 34 years	M	1.0
15 - 34 years	F*	0.9
Above 34 years	M/F*	0.9

* Pregnant and lactating women have different values. In this study however, these were lumped together with the non-lactating/non-pregnant women because the data did not allow for this level of differentiation.

Appendix 7.1 A chronology of conservation and development policies in the study area

	Details of Policy/Programme/project	Comments/Implications
1959	Creation of NCA (ordinance No. 14 of 1959) ▪ Maasai pastoralists in SNP relocated into NCA. Some moved to the present-day LGCA ▪ The relocated pastoralists promised several rights/incentives to include access to salt licks in the Ngorongoro Crater, medical and veterinary services, schools, and, food markets (grain)	▪ Removal from SNP implied more people and livestock on smaller land resources; reduced pastoral maneouvreability ▪ Inadequacies/failure in the fulfillment of the promises turned to be a centre of intense politics in the area[2]
1967	Arusha declaration – a development vision to the nation. Important policies within the declaration include: Free access to land resources (for all citizens) Free movement and settlement within villages of Tanzania	Its principle of economic equality scared off some investors including those in the tourist sector, resulting to poor services and declines in tourism and related revenue. The declines may partly explain the failure of NCAA to fulfil the promises above.
1964/65	Cultivators formerly scattered all over NCA were clustered in Endulen and Olpiro[3] to from small pockets of cultivators in these sites	This may have created a feeling of right of ownership of farms (among cultivators) in the rangelands
1968	Ban on the use of fire by pastoralists (in the NCA) in the management of pastures and parasites. ▪ Effects observed in 1980's, include bush encroachment and increased livestock diseases[4] in some areas. concentration of livestock and people in even smaller areas	Use of fire is assumed to have shaped the savannas into what they are. Effects of the ban suggest concentration of people and livestock in fewer, less affected areas.
1972	Cultivation prohibited in the Ngorongoro Crater rim; Those involved (in cultivation) were resettled outside NCA in Selela village (Monduli district), near Nayobi/Kapenjiro area.	▪ This may have created resentments; feelings of being deprived of their farms.
1974	Eviction of people and livestock from Ngorongoro Crater	▪ People and livestock concentrated on smaller land resources ▪ Curtailed access to salt licks ▪ Intensifying antagonism (pastoralists Viz. NCAA)
1975/76	Ujamaa villagisation scheme: Clustering people in permanent settlements in both NCA and LGCA Provision of pastoral development services for humans and livestock	The services are assumed to attract more people to the settlements, pastoralists and non-pastoralists alike
1980's	Opening up LGCA for cultivation – large and small, commercial and subsistence Large tracts of pastoral lands converted to farms; Land speculators into LGCA	People and livestock concentrated on smaller land resources
1992	Economic liberalisation: Economy coming under market forces rather than conditions and principles of Arusha declaration	Investors coming back; tourist facilities developed (e.g. Sopa Lodge and Serena Hotel)
1992	Lift on cultivation ban in NCA	NCA pastoralists allowed to cultivate small farms for subsistence.

[2] Literature abounds on the state of disharmony between pastoralists and the NCAA. See for example: Shivji, 1999; Parkipuny, Makacha and Ole Sayalel, 1987.

[3] Olpiro is a sub-village of Endulen, in the southern border of NCA and Karatu. It is renown for the production of onions and other vegetables.

[4] See fro example Arhem, 1981; Kikula, 1981; Misana, 1989

Appendix 7.2 Land application procedures in Tanzania

Procedures for customary tenure:

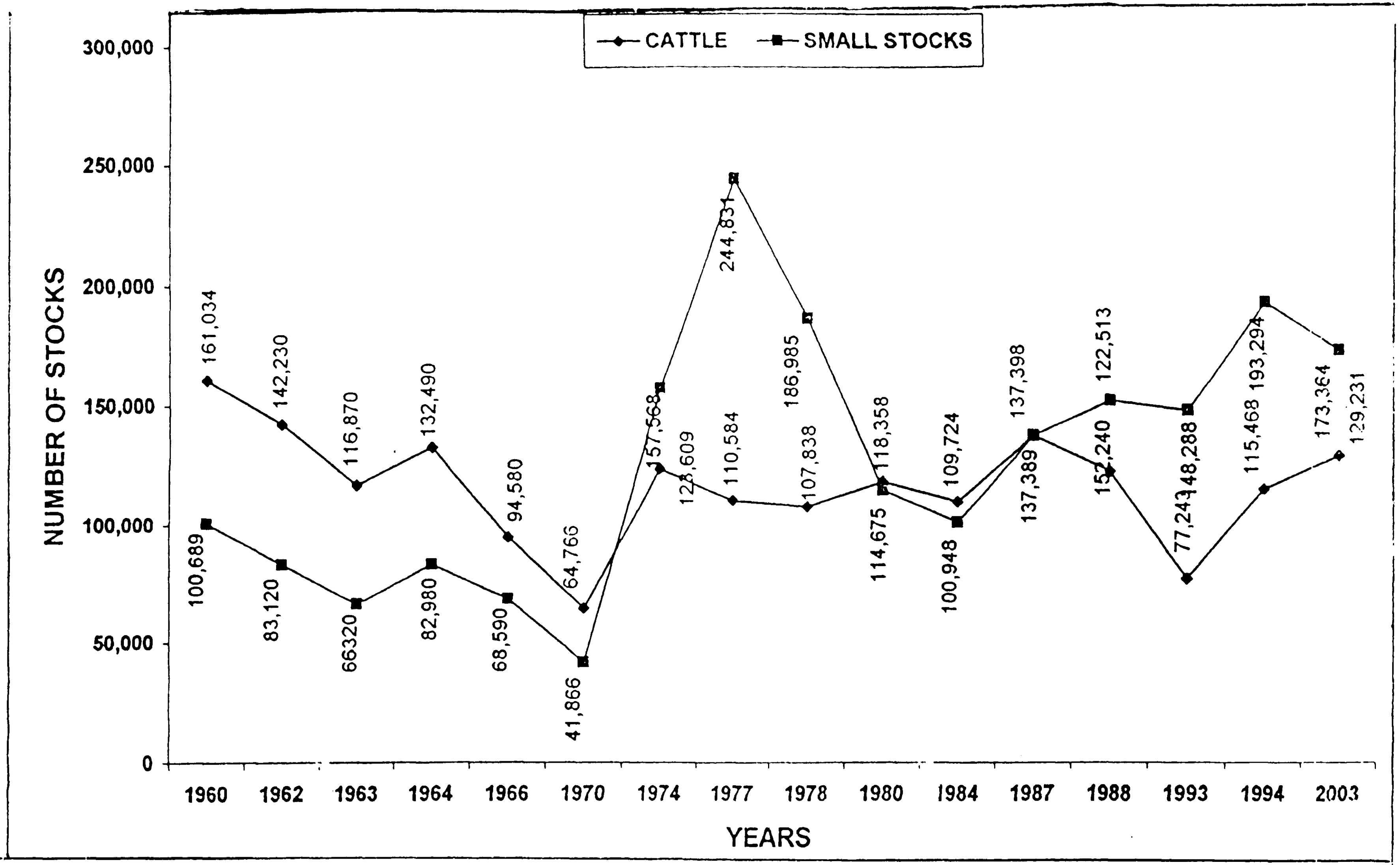
This is a procedure used at village level, under the authority of the village government. An individual (a household), on settling in a village (irrespective of whether he was born in the village or he is an in-migrant), he is entitled to land for the construction of a dwelling (homestead) and cultivation for livelihood needs. The land ranges from a minimum of 2.0 hectares. Usually it does not exceed 5.0Ha, unless under special circumstances acceptable by the village government.

Individuals apply for land to the village land committee, in person orally or by writing. The application is then discussed in the village committee dealing with land matters. The committee normally grants the request in the light of the traditional land-use plans. In some cases, it may reduce the size of land requested depending on the size of available land. If the applicant is an in-migrant, this application is considered only after presenting acceptable papers from the place of origin (to prove that he is a Tanzanian whose migration is not associated with social ills).

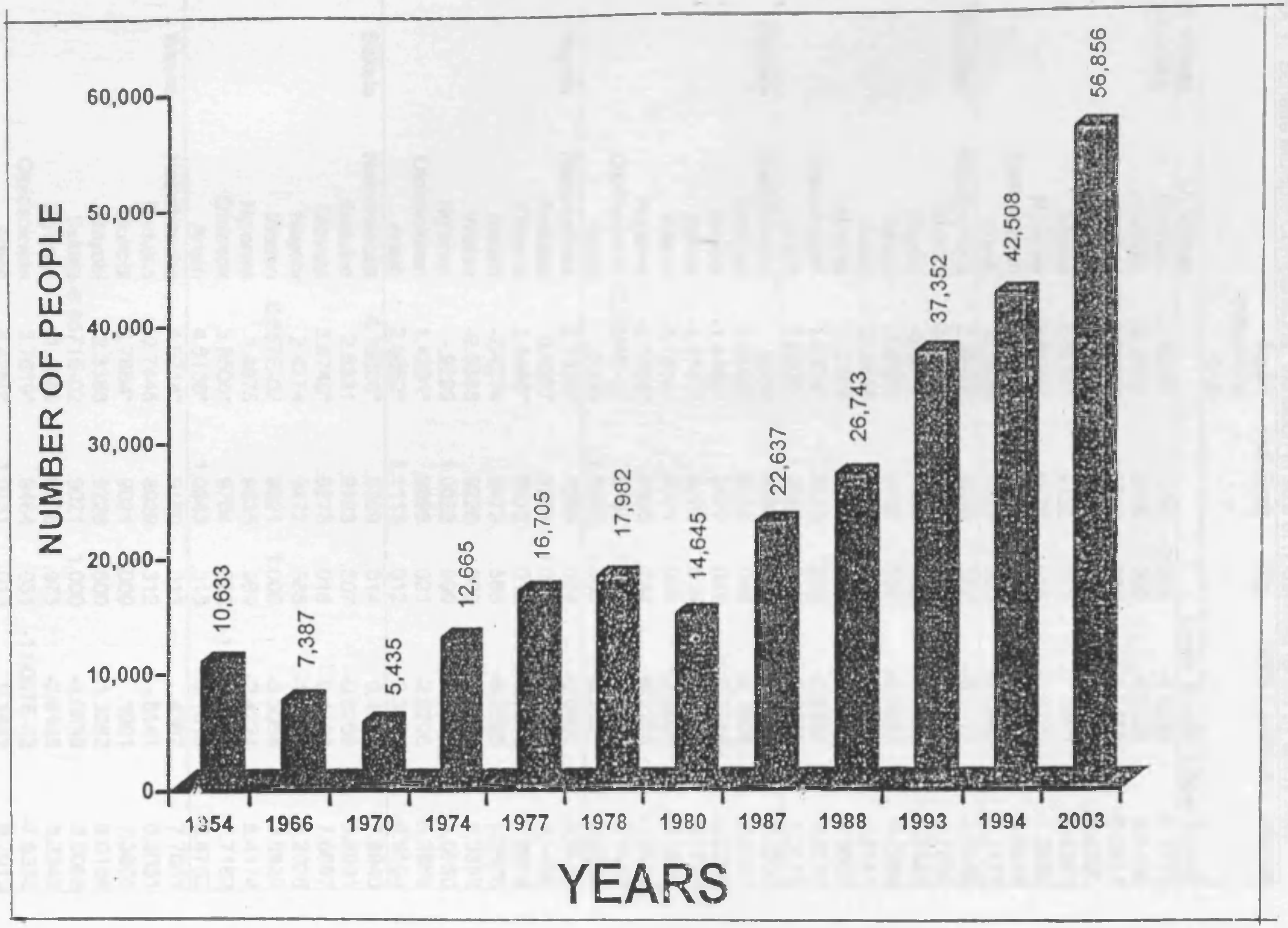
Procedures for leaseholds or rights of occupancy

This is a procedure under the central government. Individuals demanding large tracts of land (larger than the traditional subsistence requirements) apply for this in writing, to the Minister for Lands, stipulating the uses/purposes of such request. The application is however submitted to the respective District Land Committee, where it is discussed and forwarded to the Minister for Lands, usually for endorsement of the decisions made by the District Authorities. A 33 to 99 years lease/title deed is usually offered.

APPENDIX 8.1A: LIVESTOCK TRENDS IN THE NCA, 1960 – 2003



APPENDIX 8.1B: HUMAN POPULATION TRENDS IN THE NCA, 1954 - 2003



APPENDIX 9: STATISTICAL ANNEXES

ANNEX 1: Scheffe Multiple Comparisons: Variation in size of household farms by study sites

(I) Village	(J) Village	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Nainokanoka	Endulen	-2.3269*	.9280	0.042	-3.0256	-0.3717
	Oloirobi	-0.2860	.9369	1.000	-4.0200	3.4480
	Nayobi	-2.7326*	.9566	.024	-2.5453	-0.0801
	Sakala	-4.1600*	.9369	.014	-7.8940	-0.4260
	Wasso	-4.0714*	.9120	.013	-7.7061	-0.4367
	Ng'arwa	-2.6625*	.9926	.018	-6.6185	-1.2935
	Ololosokwan	-0.3095	.9796	1.000	-4.2138	3.5948
	Arash	0.3536	1.1025	1.000	-4.0406	4.7477
Endulen	Nainokanoka	2.3269*	.9280	.042	-0.3717	-3.0256
	Oloirobi	2.0409*	.9183	.049	-2.6191	-4.7009
	Nayobi	-0.4057	.9384	1.000	-4.1459	3.3346
	Sakala	-2.8331	.9183	.307	-6.4931	0.8269
	Wasso	-2.7445	.8929	.312	-6.3031	0.8141
	Ng'arwa	-1.3356	.9751	.984	-5.2218	2.5507
	Ololosokwan	1.0174*	.9619	.048	-2.8162	-0.8510
	Arash	1.6805*	1.0868	.046	-2.6509	-1.0119
Oloirobi	Nainokanoka	.2860	.9369	1.000	-3.4480	4.0200
	Endulen	-2.0409*	.9183	.049	-4.7009	-2.6191
	Nayobi	-1.4466*	.9472	.041	-2.2218	-2.3286
	Sakala	-3.8740*	.9273	.016	-7.5697	-0.1783
	Wasso	-3.7854*	.9021	.009	-7.3808	-0.1901
	Ng'arwa	-2.3765*	.9835	.044	-6.2964	-1.5434
	Ololosokwan	-2.3524E-02	.9704	1.000	-3.8912	3.8442
	Arash	.6396	1.0943	1.000	-3.7221	5.0012
Nayobi	Nainokanoka	2.7326*	.9566	.024	-0.0801	-2.5453
	Endulen	0.4057	.9384	1.000	-3.3346	4.1459
	Oloirobi	2.4466*	.9472	.018	-2.3286	-2.2218
	Sakala	-2.4274	.9472	.585	-6.2026	1.3478
	Wasso	-2.3388	.9226	.600	-6.0158	1.3382
	Ng'arwa	-.9299	1.0023	.999	-4.9248	3.0650
	Ololosokwan	1.4231*	.9895	.021	-2.5206	-5.3668
	Arash	2.0862*	1.1113	.012	-2.3430	-6.5154
Sakala	Nainokanoka	4.16008*	.9369	.014	0.4260	7.8940
	Endulen	2.8331	.9183	.307	-0.8269	6.4931
	Oloirobi	3.8740*	.9273	.016	0.1783	7.5697
	Nayobi	2.4274	.9472	.585	-1.3478	6.2026
	Wasso	8.857E-02	.9021	1.000	-3.5068	3.6839
	Ng'arwa	1.4975	.9835	.969	-2.4224	5.4174
	Ololosok	3.8505*	.9704	.022	-1.7211E-02	-7.7182
	Arash	4.5136*	1.0943	.015	0.1519	8.8752
Wasso	Nainokanoka	4.0714*	.9120	.013	.4367	7.7061
	Endulen	2.7445	.8929	.312	-.8141	6.3031
	Oloirobi	3.7854*	.9021	.009	.1901	7.3808
	Nayobi	2.3388	.9226	.600	-1.3382	6.0158
	Sakala	-8.8571E-02	.9021	1.000	-3.6839	3.5068
	Ng'arwa	1.4089	.9598	.975	-2.4165	5.2343
	Ololosokwan	3.7619*	.9464	.031	-1.0007E-02	-7.5338
	Arash	4.4250*	1.0731	.013	0.1481	8.7019

Ng'arwa	Nainokanoka	2.6625*	.9926	.018	1.2935	6.6185
	Endulen	1.3356	.9751	.984	-2.5507	5.2218
	Oloirobi	2.3765*	.9835	.044	1.5434	6.2964
	Nayobi	.9299	1.0023	.999	-3.0650	4.9248
	Sakala	-1.4975	.9835	.969	-5.4174	2.4224
	Wasso	-1.4089	.9598	.975	-5.2343	2.4165
	Ololosokwan	2.3530*	1.0243	.047	1.7295	6.4354
	Arash	3.0161*	1.1424	.023	1.5371	7.5692
Ololosokwan	Nainokanoka	0.3095	.9796	1.000	-3.5948	4.2138
	Endulen	-1.0174*	.9619	.048	0.8510	2.8162
	Oloirobi	2.352E-02	.9704	1.000	3.8442	-3.8912
	Nayobi	-1.4231	.9895	.021	5.3668	2.5206
	Sakala	-3.8505*	.9704	.022	7.7182	1.721E-02
	Wasso	-3.7619*	.9464	.031	7.5338	1.001E-02
	Ng'arwa	-2.3530*	1.0243	.047	6.4354	1.7295
	Arash	.6631	1.1311	1.000	-3.8452	5.1714
Arash	Nainokanoka	-.3536	1.1025	1.000	-4.7477	4.0406
	Endulen	-1.6805*	1.0868	.046	6.0119	2.6509
	Oloirobi	-.6396	1.0943	1.000	-5.0012	3.7221
	Nayobi	-2.0862*	1.1113	.012	6.5154	2.3430
	Sakala	-4.5136*	1.0943	.015	-8.8752	-.1519
	Wasso	-4.4250*	1.0731	.013	-8.7019	-.1481
	Ng'arwa	-3.0161*	1.1424	.023	7.5692	1.5371
	Ololosokwan	-.6631	1.1311	1.000	-5.1714	3.8452

* The mean difference is significant at the .05 level.

ANNEX 2a: Scheffe Multiple Comparisons: Conversion of rangelands and livestock wealth

Dependent Variable	(I) L'stock wealth (LE/RA)	(J) L'stock wealth (LE/RA)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Household farmland	No stock	Under 4.0	5.750E-02	.7118	1.000	-1.9508	2.0658
		4.0 - 7.99	-.7440	.8173	.842	-3.0502	1.5621
		8.0+	-4.6125*	1.0585	.000	-7.5990	-1.6260
	Under 4.0 LE/RA	No stock	-5.7500E-02	.7118	1.000	-2.0658	1.9508
		4.0 - 7.99	-.8015	.6287	.654	-2.5754	.9723
		8.0+	-4.6700*	.9206	.000	-7.2676	-2.0724
	4.0 - 7.99 LE/RA	No stock	.7440	.8173	.842	-1.5621	3.0502
		Under 4.0	.8015	.6287	.654	-.9723	2.5754
		8.0+	-3.8685*	1.0045	.003	-6.7027	-1.0342
	8.0+ LE/RA	No stock	4.6125*	1.0585	.000	1.6260	7.5990
		Under 4.0	4.6700*	.9206	.000	2.0724	7.2676
		4.0 - 7.99	3.8685*	1.0045	.003	1.0342	6.7027
Acres cultivated 1997/98	No stock	Under 4.0	-.3925	.4161	.828	-1.5665	.7815
		4.0 - 7.99	-.8560	.4778	.363	-2.2041	.4922
		8.0+	-2.4594*	.6188	.002	-4.2052	-.7135
	Under 4.0 LE/RA	No stock	.3925	.4161	.828	-.7815	1.5665
		4.0 - 7.99	-.4635	.3675	.662	-1.5004	.5735
		8.0+	-2.0669*	.5382	.003	-3.5854	-.5483
	4.0 - 7.99 LE/RA	No stock	.8560	.4778	.363	-.4922	2.2041
		Under 4.0	.4635	.3675	.662	-.5735	1.5004
		8.0+	-1.6034	.5872	.062	-3.2603	5.342E-02
	8.0+ LE/RA	No stock	2.4594*	.6188	.002	.7135	4.2052
		Under 4.0	2.0669*	.5382	.003	.5483	3.5854
		4.0 - 7.99	1.6034	.5872	.062	-5.3425E-02	3.2603

* The mean difference is significant at the .05 level.

Scheffe a, b, Homogenous groups: Rangeland conversion and livestock wealth

	Farmland			Cultiv.97/98		
	N	Subset for alpha = .05		N	Subset for alpha = .05	
Livestock wealth		1	2		1	2
Under 4.0 LE/RA	100	2.9425		30	1.9000	
No stock	30	3.0000		100	2.2925	
4.0 - 7.99 LE/RA	42	3.7440		42	2.7560	
8.0+ LE/RA	16		7.6125	16		4.3594
Sig.		.838	1.000		.421	1.000

Means for groups in homogeneous subsets are displayed.
a Uses Harmonic Mean Sample Size = 30.854.
b The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

ANNEX 2b: Scheffe Multiple Comparisons: Conversion of rangelands and sources of income

Dependent Variable	(I) Main source of income	(J) Main source of income	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Household farmland	Agropastoralism	Wage empl.	-.1669	.6711	1.000	-2.2554	1.9215
		Petty trade	1.2991	1.0494	.821	-1.9666	4.5648
		Cultivation	-.4896	.6445	.965	-2.4953	1.5161
		Ret. civil serv.	-11.0009*	1.4539	.000	-15.5252	-6.4766
	Wage employment	A/pastoralism	.1669	.6711	1.000	-1.9215	2.2554
		Petty trade	1.4661	1.1722	.815	-2.1817	5.1139
		Cultivation	-.3226	.8296	.997	-2.9042	2.2589
		Ret. civil serv.	-10.8339*	1.5448	.000	-15.6413	-6.0265
	Petty trade	A/pastoralism	-1.2991	1.0494	.821	-4.5648	1.9666
		Wage empl.	-1.4661	1.1722	.815	-5.1139	2.1817
		Cultivation	-1.7887	1.1572	.665	-5.3898	1.8123
		Ret. civil serv.	-12.3000*	1.7428	.000	-17.7235	-6.8765
	Cultivation	A/pastoralism	.4896	.6445	.965	-1.5161	2.4953
		Wage empl.	.3226	.8296	.997	-2.2589	2.9042
		Petty trade	1.7887	1.1572	.665	-1.8123	5.3898
		Ret. civil serv.	-10.5113*	1.5335	.000	-15.2833	-5.7393
	Retired civil servants	A/pastoralism	11.0009*	1.4539	.000	6.4766	15.5252
		Wage empl.	10.8339*	1.5448	.000	6.0265	15.6413
		Petty trade	12.3000*	1.7428	.000	6.8765	17.7235
		Cultivation	10.5113*	1.5335	.000	5.7393	15.2833
Acres cultivated 1997/98	Agropastoralism	Wage empl.	.1814	.3906	.995	-1.0342	1.3970
		Petty trade	1.3154	.6108	.330	-.5855	3.2162
		Cultivation	-8.5456E-02	.3751	1.000	-1.2529	1.0820
		Ret. civil serv.	-5.7096*	.8462	.000	-8.3431	-3.0762
	Wage employment	A/pastoralism	-.1814	.3906	.995	-1.3970	1.0342
		Petty trade	1.1339	.6823	.599	-.9893	3.2572
		Cultivation	-.2669	.4829	.989	-1.7695	1.2357
		Ret. civil serv.	-5.8911*	.8992	.000	-8.6893	-3.0929
	Petty trade	A/pastoralism	-1.3154	.6108	.330	-3.2162	.5855
		Wage empl.	-1.1339	.6823	.599	-3.2572	.9893
		Cultivation	-1.4008	.6735	.367	-3.4968	.6952
		Ret. civil serv.	-7.0250*	1.0144	.000	-10.1818	-3.8682
	Cultivation	A/pastoralism	8.546E-02	.3751	1.000	-1.0820	1.2529
		Wage empl.	.2669	.4829	.989	-1.2357	1.7695
		Petty trade	1.4008	.6735	.367	-.6952	3.4968
		Ret. civil serv.	-5.6242*	.8926	.000	-8.4018	-2.8466
	Retired civil servants	A/pastoralism	5.7096*	.8462	.000	3.0762	8.3431
		Wage empl.	5.8911*	.8992	.000	3.0929	8.6893
		Petty trade	7.0250*	1.0144	.000	3.8682	10.1818
		Cultivation	5.6242*	.8926	.000	2.8466	8.4018

* The mean difference is significant at the .05 level.

Scheffe a, b, Homogenous groups: Rangeland conversion and sources of income

	Farmland				Cultiv.97/98		
	N	Subset for alpha = .05			N	Subset for alpha = .05	
Main source of income		1	2			1	2
Petty trade	10	1.9000			10	1.1250	
(Agro)pastoralism	114	3.1991			28	2.2589	
Wage employment	28	3.3661			114	2.4404	
Cultivation	31	3.6887			31	2.5258	
Retired civil serv.	5		14.2000		5		8.1500
Sig.		.718	1.000			.437	1.000

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 13.272.

b The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

ANNEX 2c: Scheffe Multiple Comparisons: Conversion of rangelands and education

Dependent Variable	(I) Education level	(J) Education level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Household farmland	Non-formal	Primary, compl.	-.2035	.5713	.988	-1.8153	1.4083
		Secondary	.4592	1.2726	.988	-3.1316	4.0500
		Professional	-4.7681*	1.0986	.000	-7.8677	-1.6684
	Primary, complete	Non-formal	.2035	.5713	.988	-1.4083	1.8153
		Secondary	.6627	1.3166	.968	-3.0522	4.3777
		Professional	-4.5645*	1.1493	.002	-7.8072	-1.3219
	Secondary	Non-formal	-.4592	1.2726	.988	-4.0500	3.1316
		Primary, compl.	-.6627	1.3166	.968	-4.3777	3.0522
		Professional	-5.2273*	1.6168	.017	-9.7891	-.6654
	Professional	Non-formal	4.7681*	1.0986	.000	1.6684	7.8677
		Primary, compl.	4.5645*	1.1493	.002	1.3219	7.8072
		Secondary	5.2273*	1.6168	.017	.6654	9.7891
Acres cultivated 1997/98	Non-formal	Primary, compl.	.1059	.3335	.992	-.8352	1.0470
		Secondary	.6754	.7431	.843	-1.4211	2.7720
		Professional	-2.0268*	.6414	.021	-3.8367	-.2170
	Primary, complete	Non-formal	-.1059	.3335	.992	-1.0470	.8352
		Secondary	.5695	.7688	.908	-1.5995	2.7386
		Professional	-2.1327*	.6710	.020	-4.0261	-.2394
	Secondary	Non-formal	-.6754	.7431	.843	-2.7720	1.4211
		Primary, compl.	-.5695	.7688	.908	-2.7386	1.5995
		Professional	-2.7023*	.9440	.045	-5.3659	-3.8692E-02
	Professional	Non-formal	2.0268*	.6414	.021	.2170	3.8367
		Primary, compl.	2.1327*	.6710	.020	.2394	4.0261
		Secondary	2.7023*	.9440	.045	3.869E-02	5.3659

* The mean difference is significant at the .05 level.

Scheffe a, b, Homogenous groups: Rangeland conversion and education

	Farmland			Cultiv.97/98		
	N	Subset for alpha = .05		N	Subset for alpha = .05	
Education level		1	2		1	2
Secondary	8	2.7500		8	1.7750	
Primary, compl.	114	3.2092		55	2.3445	
Non-formal	55	3.4127		114	2.4504	
Proffessional	11		7.9773	11		4.4773
Sig.		.960	1.000		.823	1.000

Means for groups in homogeneous subsets are displayed.
a Uses Harmonic Mean Sample Size = 16.470.
b The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

APPENDIX 9: TOOLS USED IN DATA COLLECTION

MARKET SURVEY INVENTORY

Date .... Name of Market ....

Item	Tallies	Observed price per respective tally	Availability Index*
Cattle			
Small stock			
Hides & skins			
Milk & milk products			
Livestock inputs, e.g. drugs, ...			
Maize			
Beans			
Cultivation tools			
Crop production inputs			

DIETARY RECALLS INVENTORY (Tally accordingly)

Zone ………………… Village ……………………………

Head of Olmarei ……………………………………………

Head of sub-household ………………………………………

Date		Pastoral foods only	Cultivated + pastoral	Cultivated foods only	Tea +milk	Tea - milk
	Recall					
	Observ.					
	Recall					
	Observ.					
	Recall					
	Observ.					
	Recall					
	Observ.					
	Recall					
	Observ.					
	Recall					
	Observ.					
	Recall					
	Observ.					
	Recall					
	Observ.					
	Recall					
	Observ.					
	Recall					
	Observ.					
TOTAL						

GRAIN CONSUMED IN SUB-HOUSEHOLDS

Zone .... Village ....

Head of Olmarei ....

Head of sub-household .... Ref. Adults ....

Date	**Quantity of grain**	**Source***	**Actual/estimated value (TShs.)**	**Date started consumption**	**Days lasted**

* 1 = Own cultivation; 2 = Purchases using livestock proceeds; 3 = Exchange with livestock; 4 = Purchases using own savings; 5 = Gifts; 6 = Food aid

OBSERVED HOUSEHOLD PURCHASES (includes all sub-households in Olmarei)

Zone .... Village ....

Head of Olmarei ....

Head of sub-household ....

Date	**Items**	**Quantity per item**	**Source of money***	**Total cost per quantity**	**Remarks**

* 1 = sales of cultivated crop; 2 = sale of cattle; 3 = sale of small stock; 4 = sale of l'stock products; 5 = Own savings and/or remittances

HOUSEHOLD (OLMAREI) QUESTIONNAIRE: SOCIO-ECONOMIC SURVEY, NGORONGORO DISTRICT, TANZANIA 1998 - 1999

(ROUND 1)

DATE ------------------- **Interviewer** --------------------------

ID No.

A IDENTIFICATION

Division ------------------------- (Zone No. -------) Village ---------------------- (Site No.------)

Boma No.------------------- Name of Head of Boma --

Olmarei No. --------------- Name of Head of Olmarei -------------------------------------

B. BACKGROUND INFORMATION

1. Head of Household

Age	Educ. level	Ethnic origin	Year started living in this village	Village/district was living before coming to this village	Village/district where was born	Other villages/ districts has lived before

1. Circle the main economic activity providing subsistence for this Olmarei

1. Herding 2. Cultivation 3. Wage employment 4. Trade 5. Other (specify) -----------

2. Circle other economic activities done by yourself

1. Herding 2. Cultivation 3. Wage employment 4. Trade 5. Other (specify) -----------

C. LIVESTOCK

1. Do you own livestock? Y/N ---------- If yes, about how many? (if willing perform gate counts)

Description	Bulls	Cows	Heifers	Steers	Calves (1 - 2yr)	Calves (0 - 1 yr)	S/Stock	TLU**
In this Olmarei								
Elsewhere								
Total								

2. For the livestock in this *olmarei*, how are they distributed among your sub-households?

Description	Adults	Calves (0 - 1yrs)	S/Stock	TLU**
H/Olmarei				
Sub-hh 1				
Sub-hh 2				
Sub-hh 3				
Total				

3. What do you consider to be the major problems for your livestock development?

1. --

2. --

4 Apart from livestock, what other means does your O'marei subsist on? (Circle)

1. Cultivation 2. Food aid 3. Causal labour 4. Petty trade 5. Wage employment

6. Handicraft (eg. beadworks) ++. Others (specify) 7. -------------------------

D. LAND TENURE

1. Have you built a new boma in the last three years? Y N If yes, where was the old boma? --------

2 Was your hh cultivating in the old boma? Y N

If yes, what crops? 1.------------------- 2. -----------------

Was that land cultivated in the last season? Y N

3. Who owns the land in the old boma now? 1. Myself 2. Children 3. Relatives 4. None

4. Do you intend to move your boma to another place Y N If yes, where? ----------------------

Why move? --

5 What will you do with the farms in this boma? 1. continue cultivating 2. allocate to sons

3. retain as family property when not cultivating 4. give to relatives 5. abandon

6. How many farm plots (fields) does your family (olmarei) own in this village? -------------------------

	Plot 1	Plot 2	Plot 3	Plot 4
Acres				
Year acquired				
How acquired				
Land quality **				
Distance from homestead				
Distance from nearest market **				

7. Have you increased the size of your farms in the past five years? 1. Yes 2. No

If yes, by how many acres? --

How were they obtained? 1. --------------------- 2. ----------------- 3. ------------------

Why did you increase? ---

8. Have you reduced the size of your farms in the past five years? 1. Yes 2. No

If yes, by how many acres? ---

How reduced? 1. --------------------- 2. ------------------ 3. ------------------

Why did you reduce? --

CULTIVATION (AND OTHER SOURCES OF GRAIN)

1. What crops did you cultivate and harvest last rainy season 1997/98 (exclude individ. sub-households)

Crop	Maize only	Beans only	Maize & beans	Irish potatoes	Sweet potatoes	Vegetable	Other (specify)
Acres cultivated & harvested							
Distance from household							
Distance from nearest market							
Land class							
Sacks harvested							

2. Did you cultivate any crops which, unfortunately, was not harvested in the 1997/98 rainy season?

Crop	Maize only	Beans only	Maize & beans	Irish potatoes	Sweet potatoes	Vegetable	Other (specify)
Acres cultivated not harvested							
Distance from household							
Distance from nearest market.							
Why not harvested?							

3. Did the harvested crop last the whole year? 1 Yes 2 No
4. Did you:
   - sell some of your crop 1 Yes 2 No. If yes, how many sacks? ....
   - give as gift 1 Yes 2 No. If yes, how many sacks? ....
   - exchange with livestock? 1 Yes 2 No. If yes, how many sacks? ....

4. If crop did not last whole year, how did your household survive? (circle)

   1. Food aid 2. Gifts 3. Bought food from own savings 4. Sold livestock

   5. Casual labour 6. Remittances ++ Other 6. ---------------- 7. ---------------------

5. Bags of food crops received by h/h head this month's market day or after

Sacks of	Bought cash	Bought with l'stock	Gifts	Food aid
Maize/Maize				
Maize flour				
Beans				

6. Food crop given out by h/h head this month's market day or after (estimate in sacks)

Sacks of:	Sold in cash	Purchased l'stock	Gift to relatives	
Maize or Maize flour				
Beans				

7. Total cultivable acres owned by h/h head this year, 1998/99 (exclude land under sub-households)

Cultivated , harvested	Cultivated, not harvested	Fallow	Leased out	Total

8. What tools do you use in cultivation? 1.--------------- 2. -------------- 3. -------------- 4. ----------------

9. Did you use any fertilisers in 1. last season? Y/N 2. This season Y/N (Circle)

If yes, name the types used 1. ------------------- 2. ---------------------- 3. -----------------------

10. What crops have you planted this season? (1998/99)

Crop	Maize only	Beans only	Maize & beans	Irish potatoes	Sweet potatoes	Vegetable	Other (specify)
Acres cultivated							
Distance from household							
Distance from nearest market							
Land class							

11. How many people (labourers) did you hire this season during: Tilling ------ Weeding -------

How many came from: Within the village ---------- Outside the division -----------------

12. Do you inend to cultivate more acres this season (1998/99)? ----------------------

If yes, about how many? -----------------------

Why cultivate more?

1. --

2. --

3. --

HOUSEHOLD (OLMAREI) QUESTIONNAIRE: SOCIO-ECONOMIC SURVEY, NGORONGORO DISTRICT, TANZANIA 1998 - 1999

(ROUND 2)

DATE ------------------- Interviewer ----------------------------

ID No.

A IDENTIFICATION

Division ------------------------- (Zone No. -------) Village --------------------- (Site No.------)

Boma No.------------------- Name of Head of Boma ---

Olmarei No. --------------- Name of Head of Olmarei -------------------------------------

A. LIVESTOCK

1. Tell me of the livestock you currently own. How many are they? (if willing perform gate counts)

Description	Bulls	Cows	Heifers	Steers	Calves (1 - 2yr)	Calves (0 - 1 yr)	S/Stock	TLU**
In this Olmarei								
Elsewhere								
Total								

2. For the livestock in this *olmarei*, how are they distributed among your sub-households?

Description	Adults	Calves (0 - 1yrs)	S/Stock	TLU**
H/Olmarei				
Sub-hh 1				
Sub-hh 2				
Sub-hh 3				
Total				

3. Tell me about the livestock you bought since my last visit (all sub-households)

	Bulls	Cows	Heifers/steers	Shoats	TLU
Number bought					
Value					

4. Livestock gained through other ways e.g. fines, dowry gifts etc. since my last visit

	Adults	Calves (0 - 12 months)	Shoats	TLU
Fines, dowry, gifts				
Births	NA			

5. Tell me of the sales you made in your livestocks ince my last visit

No. sold for	Bulls	Cows	Heifers/steers	Shoats	TLU
No.					
Value					
Purpose					

6. Other forms of livestock exit since my last visit

	Bulls	Cows	Heifers/steers	Shoats	TLU
Home consumption					
Gifts and fines					
Deaths					
Total					

7. What do you consider to be the major problems for your livestock development?

1. --

2. --

3. --

B. CULTIVATION AND OTHER SOURCES OF FOOD

1. What crops did you harvest this rainy season of 1998/99? (measure/estimate when hh is willing)

Crop	Maize only	Beans only	Maize & beans	Irish potatoes	Sweet potatoes	Vegetable	Other (specify)
Acres							
Sacks. harv.							

2. Use of harvested crop (crop of 1998/99)

Desc ription		Sold cash	exchanged with l'stock	Gifts out	Ceremonial uses	Balance in store	Livestock gained by crop exchange
Maize	Sacks						No.
	value						Value
Beans	sacks						No.
	value						Value
I/potatoes	sacks						No.
	value						Value
Vegetables	Kg						No.
	Value						Value

3. Grain (and other foods) received by hh head since last market day of this month

Description		bought cash	exchanged with l'stock	Gifts in	Food aid	Livestock given out - exchanged with food
Maize	Sacks					No.
	value					Value
Beans	sacks					No.
	value					Value
I/potatoes	sacks					No.
	value					Value

4. Do you intend to increase the size of your farms during the next season? Y N

If yes, why?

1. --

2. --

How many acres do you intend to cultivate in the next rainy season (1999/2000)? -------------

5. Do you intend to cultivate crops different from those you are currently cultivating? Y N

If yes, what crops would you like to cultivate? 1 ------------ 2.----------------- 3. ------------

Why would you like to cultivate these crops?

1. --

2. --

6. What would you call the good side (benefits) of doing both cultivation and herding?

1. --

2. --

3. --

7. What would you consider as problems emerging from doing both cultivation and herding?

1. --

2. --

3. --

4. --

SUB-HOUSEHOLD (ENKAJI) QUESTIONNAIRE: SOCIO-ECONOMIC SURVEY, NGORONGORO DISTRICT, TANZANIA 1998 - 1999

DATE ------------------- **Interviewer** ---------------------------

A IDENTIFICATION ID. No. /__/__/__ __/__ __/__ __/

Division -------------------------- (Zone No. -------) Village ----------------------- (Site No.------)

Boma No.------------------- Name, of Head of Boma ---

Olmarei NO. --------------- Name of Head of Olmarei -------------------------------------

Sub household No. --------------- Name of head of sub household (enkaji/) ----------------------------

1. When did you come into this household? -----------------------------
2. Where were you living before coming here? --------------------------
3. What is the herd size allocated to this enkaji?

   Bulls -------- Cows --------- Heifers/ steers Calves ---------

4 How many cows are currently milked for this enkaji? ----------------

   Are you milking the residual herd this week? Y N

5. How much milk did you obtain from the herds you milked

	Enkaji herd	Residual herd	Total
Yesterday evening			
This morning			
Total			

(calabashes may be measured for metric estimates)

6. Do you sell some of the milk? ------- Y N
7. If yes, indicate milk sales in the table below

	S/hh herd		Residual herd	
	Litres	TAS	Litres	TAS
Yesterday evening				
Today morning				
Total				

B. DEMOGRAPHIC AND SOCIO-ECONOMIC DATA

S/hh No. (enkaji)	S/No	Name	Sex	Age	Relation	Educ.	Village/District of birth	Year settled in this village/div	Zone/distrr. where was living before	Main econ. occupation	Other /seasonal activities

Codes

Relation	*Sex*	*Education level*	*Former destination*	*Main occupation*
Head of hh 1	*Male* 1	*Non formal* 1	*Inside the NP* 1	*Livestock keeping* 1
Spouse 2	*Female* 2	*A/Educ &/or*	*In the zone* 2	*Cultivation* 2
Relative 3		*Incompl Pr. ed.* 2	*Other SEU b/zone* 3	*Wage employee* 3
Dom.Servant 4		*Pr. Education* 3	*Neighbouring district* 4	*Business* 4
Labourer 5		*Sec. educ.* 4	*Neighbouring region* 5	*Other (specify)* 5
Other 6		*College/proff. ed.* 5		

PRODUCTION AND CONSUMPTION

1. What crops did your enkaji cultivate last rainy season?

Crop	Maize only	Beans only	Maize & beans	Irish potatoes	Sweet potatoes	Vegetable	Other (specify)
Acres							
Debes. harv.							

2. Did the harvest last the whole year? 1 Yes 2 No

3. Did you sell, ive as gift, exchange with l'stock some of the crop harvested? 1 Yes 2 No

4. If crop did not last whole year, how did your household survive? (circle)

1. Food aid 2. Gifts 3. Bought food from own savings

5. Casual labour 6. Remittances 7 Food from Olmarei head 7. Other ------------------

5. Did you buy or receive any grain for food this week/last market day? 1. Yes 2. No

Debes of grain/other foodstuffs received by head of enkaji this week

Debes of	Bought cash	Bought with l'stock	Gifts	Food aid
Maize/Maize flour				
Beans				
Potatoes				
Other (specify)				

6. Food crop given out by head of enkaji this week (Estimate in *debes*)

Debes of:	Sold in cash	Purchased l'stock	Gift to relatives	
Maize or Maize flour				
Beans/peas				
Potatoes				
Other (specify)				

7. Total cultivable acres owned by sub-hh this year (exclude land under other sub-households)

Cultivated, harvested	Cultivated, not harvested	Fallow	Leased out	Total

8. In which year did you start cultivating your farms? -----------------

Why? --

----

9. What tools do you use in cultivation? 1.-------- 2. ---------- 3. ------------ 4. -------------

10. Did you use any fertilisers in the last season? Y/N ---------

If yes, name the types used 1. ---------------------- 2. ---------------- ---------

11. How many people (labourers) did you hire in the last season during:

Tilling --------- Weeding ---------- Harvesting ----------------

12. Would you know where they came from? Y/N -------- If yes, how many came from:

Within the village/division? --------------------- Outside the division? ---------------------

13. Have you increased the size of your farms in the past five years? 1. Yes 2. No

If yes, by how many acres? --

How were they obtained? 1. --------------------- 2. ------------------- 3. -------------------

Why did you increase? ---

----

14. Have you reduced the size of your farms in the past five years? 1. Yes 2. No

If yes, by how many acres? --

How reduced? 1. ---------------------- 2. ------------------- 3. -------------------

Why did you reduce? --

----

15. Do you own farms elsewhere? Y N If yes, where? --

16. List the different economic activitieas undertaken by you and/or other members of this enkaji

1. ---

2. --

3. --

4. ---

QUESTIONNAIRE TO OTHER CULTIVATING ADULTS IN THE OLMAREI

SOCIO-ECONOMIC SURVEY, NGORONGORO DISTRICT, TANZANIA 1998 - 1999

DATE ------------------- **Interviewer** ----------------------------

A IDENTIFICATION ID. No. /__/__/__/__ __/__ __/

Division ------------------------ (Zone No. -------) Village ---------------------- (Site No.------)

Boma No.-------------------- Name, of Head of Boma ---

Olmarei NO. ---------------- Name of Head of Olmarei --------------------------------------

Name of respondent --

Sex ----- Age -------- Where born -------------------- Education ---------- Occupation ----------------

A. Background

1. What is your relationship with household head? ---------------------

2. When did you come into this household? -----------------------------

3. Where were you living before coming here? -------------------------

B Economic activities

1. What crops did your enkaji cultivate last rainy season?

Crop	Maize only	Beans only	Maize & beans	Irish potatoes	Sweet potatoes	Vegetable	Other (specify)
Acres							
Debes. harv.							

2. Total cultivable acres owned by respondent this year

Cultivated, harvested	Cultivated, not harvested	Fallow	Leased out	Total

3. How were these plots acquired?

	Plot 1	Plot 2	Plot 3	Plot 4
Acres				
Year				
How acquired				

4. In which year did you start cultivating your farms? ------------------

Why? --

5. What do you do with your crops eg.

1. Feeed my family elsewhere, 2. Sell, 3. Exchange with livestock 4. Other --------------

6. What tools do you use in cultivation? 1.-------- 2. ---------- 3. ------------ 4. -------------

7. Did you use any fertilisers in the last season? Y/N ---------

If yes, name the types used 1. ---------------------- 2. ---------------- ---------

8. How many people (labourers) did you hire in the last season during:

Tilling --------- Weeding ---------- Harvesting ----------------

9. How many came from: Within the village/division? -------------- Outside the division? ------------------

10. Have you increased the size of your farms in the past five years? 1. Yes 2. No

If yes, by how many acres? ---

How were they obtained? 1. --------------------- 2. ------------------ 3. -------------------

Why did you increase? ---

11. Have you reduced the size of your farms in the past five years? 1. Yes 2. No

If yes, by how many acres? ---

How reduced? 1. --------------------- 2. ------------------ 3. ------------------

Why did you reduce? ---

12. Do you own farms elsewhere? Y N If yes, where? --

13. List the different economic activitieas you undertake in this village/outside the village

1. --

2. --

3. --

14. What were your main reasons for coming to this place? ------------------

15. Did you have any relatives in this place before coming to this household? Y N

If yes, of what relatioship? --

16 Do you have relatives who have also moved into this division? Y N

If yes, what are they doing as a means of living? e.g.

1. Cultivating 2. Petty trade 3. Wage employment 4. Herding 5. Other ------